

HAMILTON HARBOUR WATER MOVEMENTS 1976-77

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Ministry
of the
Environment

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HAMILTON HARBOUR

WATER MOVEMENTS
1976 - 77

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HAMILTON HARBOUR WATER MOVEMENTS

<u>TABLE OF CONTENTS</u>	<u>PAGE</u>
LIST OF TABLES	i
LIST OF FIGURES	ii
FORWARD	iii
ACKNOWLEDGEMENT	iv
SUMMARY	v
 INTRODUCTION	 1
 RESULTS	
CURRENTS	2
Hamilton Harbour	2
Burlington Canal	2
Desjardins Canal	5
AUTOSPECTRA	6
Hamilton Harbour	6
Burlington Canal	6
Desjardins Canal	7
WATER TEMPERATURE	8
Hamilton Harbour	8
Burlington Canal	8
Desjardins Canal	8
 CONCLUSIONS	 9
 REFERENCES	 11
 APPENDIX 1	 39

LIST OF TABLES

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
1	Current Instrument Operations in Burlington and Desjardins Canals and Hamilton Harbour, Lake Ontario 1976-77	13
2	Statistical Summary of Current Meter Operations, Hamilton Harbour, Lake Ontario, 1976-77	14
3	Statistical Summary of Current Meter Operations, Burlington Canal, Lake Ontario, 1967-77	15
4	Flow Through Burlington Canal, Lake Ontario, 1976	19
5	Comparison of Flow Through Burlington Canal	20
6	Statistical Summary of Current Meter Operations, Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976	21
7	Flow Through Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976	22
8	Summary of Major Spectral Periods (Hours), Hamilton Harbour, Lake Ontario, 1976-77	23
9	Summary of Major Spectral Periods (Hours), Burlington Canal, Lake Ontario, 1976	24
10	Summary of Coherences (95% Confidence), Burlington Canal, Lake Ontario, 1976	25
11	Summary of Major Spectral Periods (Hours), Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976	26
12	Temperature Frequency, Hamilton Harbour, Lake Ontario, 1976	27
13	Temperature Frequency, Burlington Canal, Lake Ontario, 1976-77	28
14	Temperature Frequency, Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976	30

LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1	Resultant Currents in Hamilton Harbour, Lake Ontario, 1976-77	31
2	Resultant Currents in Burlington Canal, Lake Ontario, 1976-77	32
3	Resultant Currents in Burlington Canal, Lake Ontario, 1976-77	33
4	Resultant Currents in Burlington Canal, Lake Ontario, 1976-77	34
5	Mean Temperature in Burlington Canal, Hamilton Harbour, Lake Ontario, 1976-77	35
6	Exchange through Burlington Canal, Lake Ontario, 1975-76	36
7	Resultant Currents in Desjardins Canal, Hamilton Harbour, Lake Ontario 1976	37
8	Exchange through Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976	38

HAMILTON HARBOUR WATER MOVEMENTS

FOREWORD

This report is a part of the ongoing multi-disciplinary study of the Hamilton Harbour which commenced in 1972. This report will form a section of the proposed Hamilton Harbour Study 1977, to be published early 1980.

Previous studies of water movement have been published in earlier Hamilton Harbour Study Reports 1974 to 1976.

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HAMILTON HARBOUR WATER MOVEMENTS

SUMMARY

Physical processes of Hamilton Harbour were studied during 1976 and 1977 by operating self-recording current instruments at a mid-harbour location and in the Burlington and Desjardins Canals. In the harbour, the resultant currents varied from 0.7 to 1.8 cm.s^{-1} ; in Burlington Canal, they ranged between 0.6 and 13.4 cm.s^{-1} and in Desjardins Canal, they were from 3.3 to 8.1 cm.s^{-1} . Both the connecting canals exhibited faster currents compared to the mid-harbour and lake coastal regions, probably due to the constriction of the canals.

Flows through the two canals were estimated in both directions from measured currents. The exchange through Burlington Canal was an order of magnitude larger than through Desjardins Canal. Net flow through Burlington Canal was 0.2 to 1.4% of the harbour volume per day, towards Lake Ontario. Net flow through Desjardins Canal varied from 0.07 to 0.15% of the harbour volume per day, towards the harbour.

The spectral analysis of the currents at the mid-harbour showed diurnal and semi-diurnal periods and the effects of Lake Ontario. The analysis for the two canal locations indicated predominant tidal effects as well as the first two oscillation modes of Lake Ontario. At Burlington Canal, significant coherences were observed from 2 to 30 h between different layers from June to August 1976, including vertical homogeneity of currents and water temperature in the canal. Such a vertical homogeneity in other years may or may not exist.

The mean water temperatures in the harbour ranged from 17.6 to 19.2°C during summer 1976. Burlington Canal mean water temperatures ranged from 6.6 to 20.9°C , June to November 1976-77. A weak stratification of the Canal was observed during summer 1976, followed by no stratification from October to November 1976. The mean water temperatures in Desjardin Canal varied from 4.5 to 20.8°C from May to November 1976.

HAMILTON HARBOUR WATER MOVEMENTS

INTRODUCTION

Hamilton Harbour is a natural harbour located in the northwest corner of Lake Ontario. It contains $280 \times 10^6 \text{ m}^3$ of fresh water and has a mean depth of 13 m. The harbour is connected to Lake Ontario by Burlington Canal and to Cootes Paradise by Desjardins Canal (see Figure 1). The port is very important to the heavy industries on southern shores. The industry uses and recirculates $27 \text{ m}^3 \cdot \text{s}^{-1}$ (0.8% of harbour volume per day) of harbour water. Several creeks discharge $4.1 \text{ m}^3 \cdot \text{s}^{-1}$ of water to the harbour while the municipal sewage outfalls add $3.2 \text{ m}^3 \cdot \text{s}^{-1}$ of treated effluents.

The Ontario Ministry of the Environment (MOE) has been concerned with the water quality of the harbour how the biological, chemical and physical processes and their complex interactions affect it (MOE, 1974, 1975 and 1977). During summer of each year, hypolimnion waters experience oxygen depletion. Polak and Haffner (1978) concluded that the exchange of water between the harbour and the lake provide the much needed dissolved oxygen to the harbour. Lake-harbour exchange was estimated to be 1% of the harbour volume per day while the net flow towards the lake was 0.5% of the harbour volume per day during September 1975 (Kohli, 1979).

This report discusses the results of the 1976-77 current meter operations in the harbour, Burlington and Desjardins Canals, including lake-harbour and harbour-Cootes Paradise exchange and the physical processes responsible for the currents and is a continuation of the series of reports on Hamilton Harbour physical data (MOE, 1974, 1975 and 1977; Kohli, 1978 and 1979).

Table 1 presents the current meter operations in Hamilton Harbour, Burlington and Desjardins Canals during 1976-77. All current meter sites are shown in Figures 1 to 4 and 7. Locations 1117, 1116, 1101 and 1102 were on the same tower in Burlington Canal at different

depths (see Table 1). All instruments were operated in the epilimnion, except 1102 which was in the hypolimnion. All data collected were numerically smoothed (see Appendix 1) and then partitioned into monthly data sets (records). Statistical analyses of water movements and temperatures were performed to determine the spatial and temporal characteristics. Currents at the Burlington Canal locations were examined to compute the lake harbour exchange using the excursion episode method (Kohli, 1979). Estimates of the flow through Desjardins Canal were made using average currents and the approximate cross-sectional area of the canal.

RESULTS

CURRENTS

Hamilton Harbour

Figure 1 shows the resultant southerly direction of currents during the stratified summer months of June to August 1976-77. Similar observations were made during August and September 1975 (Kohli, 1978). The resultant currents at the mid-harbour location (1104) varied from 0.7 to 1.8 cm.s^{-1} while the arithmetic average speed ranged from 1.7 to 4.8 cm.s^{-1} (see Table 2). The maximum speed recorded at this location during 1976-77 summers was 28 cm.s^{-1} . The persistence factor varied from 0.11 to 0.40 during this study. The results of the present investigation compared favourably with the previous study (Kohli, 1978).

Burlington Canal

Table 3 and Figures 2-4 present the summary of currents in Burlington Canal during 1976 and 1977. Figures 2 and 3 indicate that the resultant currents at the top two locations, 1117 and 1116 (8.5 m and 7.5 m from bottom) were towards the lake for the entire period of study. However at 1101, 6.1 m from the bottom, the resultant currents were toward the lake from June to November 1976,

but they were toward the harbour from May to July 1977 (see Figure 4). The direction of net currents at 2.1 m from the bottom (the lowest location 1102), was towards the canal wall during June and July 1976. At this site (1102), the recorded currents were integrated over 10 minutes and were less than 2 cm.s^{-1} for approximately 96% of the time during June and July 1976 (see Tables 1.25 and 1.26 in Appendix 1). Therefore, most of the recorded speeds were actually less than the threshold speed of the Plessey Current Meters (3 cm.s^{-1}). When the current speed is less than the instrument threshold speed, the direction vane can assume any random position and the direction recording becomes meaningless. Therefore, the computed resultant current direction towards the canal wall, in this case, was meaningless. Thus it may be concluded that the net currents in the canal are predominantly towards the lake.

At location 1117 (8.5 m from bottom) the resultant currents ranged from 0.9 to 13.4 cm.s^{-1} while the arithmetic average speed varied from 7.6 to 16.7 cm.s^{-1} (see Table 3). The maximum speed recorded during the study ranged from 25 to 83 cm.s^{-1} . At location 1116 (7.5 m from bottom), the resultant currents varied from 2.3 to 6.8 cm.s^{-1} while the arithmetic average speed ranged from 7.8 to 14.7 cm.s^{-1} (see Table 3). The maximum speed recorded during the study varied from 48 to 129 cm.s^{-1} . The resultant current at 6.1 m from the bottom (location 1101) varied from 0.6 to 7.6 cm.s^{-1} , while the arithmetic average speed ranged from 6.9 to 14.1 cm.s^{-1} (see Table 3). The maximum speed recorded at this level was between 44 and 126 cm.s^{-1} . The resultant speed at the 2.1 m from the bottom (location 1102) was 0.5 cm.s^{-1} during June and July 1976. The arithmetic average speed during June 1976 was 0.6 cm.s^{-1} and during July 1976, it was 0.7 cm.s^{-1} . The level being closer to the bottom registered the slowest currents in the canal. More specifically, the currents here were negligible for 49% of the time and less than 2 cm.s^{-1} for 95% of the time during June 1976. In July 1976, the currents were negligible for 30% of the time and less than 1 cm.s^{-1} for 70% of the time. The maximum speed recorded was 25 cm.s^{-1} during June 1976 and 3 cm.s^{-1} during July 1976. In

view of the very small currents (less than the instrument threshold speed of 3.0 cm. s^{-1}) persisting over longer periods of time, the results of the lowest location (1102) may be used but with due caution.

The results of the top three current meters (1117, 1116 and 1101) are comparable to the earlier study (Kohli, 1978). The resultant currents of 0.6 to 13.4 cm.s^{-1} (present study) compare well with 1.1 to 15.2 cm.s^{-1} during 1972 to 1975 (Kohli, 1978). The maximum speed recorded during the present study was 129 cm.s^{-1} which compares well with the 144 cm.s^{-1} of the previous study. These faster currents in the canal may be attributed to the canal constriction (van de Kreeke, 1976) and the Helmholtz mode of the harbour (Freeman, Hamblin and Murthy, 1974).

Careful examination of the current statistics of Burlington Canal (see Table 3) shows that the magnitude of the resultant current, as well as the arithmetic average speed, decreases with depth. Figures 2, 3 and 4 show that the resultant currents in Burlington Canal were generally towards the lake at all three levels, except during May to July 1977 at location 1101 (see Figure 4), when the resultant currents were going towards the harbour. This shift in direction of the resultant currents at 1101 and the presence of a layered flow system in Burlington Canal during summer 1977, in contrast to the unidirectional flow during the summer 1976, was confirmed by the mean water temperatures (see Figure 5). A sharp temperature drop of $8-9^{\circ}\text{C}$ was observed between locations 1116 and 1101 during summer 1977 while the temperature drop between the same locations and during the same period of 1976 was $1-2^{\circ}\text{C}$.

Flows through Burlington Canal were computed by the excursion-episode method (Kohli, 1979) and the results for the period June to November 1976, are presented in Table 4. As expected, the net exchange was towards the lake. The total exchange varied from 1.1 to 1.6% of the harbour volume per day, while the net exchange towards the lake ranged from 0.2 to 1.4% of the harbour volume per day (see Figure 6). These results compare well with the previous estimates when the total exchange was 1.0% of the harbour volume per

day, while the net exchange towards the lake was 0.5% of the harbour volume per day (Kohli, 1979) during September 1975. Harris et al (1979) computed the average mass exchange through Burlington Canal, based on the mass balance of total dissolved solids in the harbour over a year. Their results are compared with the present study and Kohli (1979) in Table 5. Harris' calculations assume the harbour to be in steady state over a year - an unreasonable assumption in an otherwise dynamic harbour. Table 5 shows that Harris' flow estimates towards the lake and the harbour are 2 and 7 times larger than the excursion-episode estimates, but their net flow estimates toward the lake are 40% of those by the excursion-episode method. As the excursion-episode method computes the flows from direct measurements in the canal, taking account of the periodic transport, it is considered a better method.

Desjardins Canal

Desjardins Canal is located at the western end of Hamilton Harbour (see Figures 1 and 7), connecting the harbour to the Cootes Paradise. A single current meter at the mid-depth (location 1109) operated under the railway bridge, from 27 May to 24 November 1979. Only one instrument could be installed on a tower, due to the shallow depth of 3.7 m. A summary of current statistics is presented in Table 6. The resultant currents varied from 3.3. to 8.1 cm.s^{-1} , while the arithmetic average speed ranged from 9.8 to 24.2 cm.s^{-1} . The maximum speed recorded was 88 cm.s^{-1} . The faster currents in the canal may be attributed to the constriction (van de Kreeke, 1976).

Based on the average current speed towards the Harbour and Cootes Paradise, with the corresponding percentages of occurrence, the flow in both directions was computed for the period May to November, 1976. As such estimates are 2 to 3 times larger than the excursion-episode method (Kohli, 1978), a correction factor of 2.5 has been applied to obtain the more realistic estimates of the flow presented in Table 7. The total exchange through the canal varied from 0.07 to 0.15% of the harbour volume per day (see Figure 8),

while the net exchange was 0.02 to 0.05% of the harbour volume per day (average net flow of $1.11 \text{ m}^3 \cdot \text{s}^{-1}$), towards the harbour. The exchange through the Burlington Canal is an order of magnitude larger than through the Desjardins Canal. Spencer Creek discharges an average of $0.81 \text{ m}^3 \cdot \text{s}^{-1}$ from June to November (1961-75), while the Dundas STP discharges an average of $0.12 \text{ m}^3 \cdot \text{s}^{-1}$ into Cootes Paradise (Semkin et al, 1976). Thus, Spencer Creek and Dundas STP, together add $0.93 \text{ m}^3 \cdot \text{s}^{-1}$ to Cootes Paradise while the net average outflow from Cootes Paradise to Hamilton Harbour was computed as $1.11 \text{ m}^3 \cdot \text{s}^{-1}$. The small difference of $0.18 \text{ m}^3 \cdot \text{s}^{-1}$ may be attributed to other smaller creeks flowing into Cootes Paradise, ground water or precipitation.

AUTOSPECTRA

Hamilton Harbour

Table 8 presents a summary of the major spectral periods observed at the mid-harbour location (1104). Diurnal (24.0 h) and semi-diurnal (12.0 h) periodic motions were observed in the east-west directions during July 1976. Semi-diurnal oscillations were also observed along the north-south direction during June 1976 and July 1977. These are associated with the lunar tidal motions. The 17.1 h (August 1976) and 20.0 h (June 1977) periods along the north-south direction were due to the lake-wide seiche. In June 1977, along the east-west direction, 3.6 and 4.6 h periods were significant and these may be due to the lower modes of free oscillations of Lake Ontario (Rockwell, 1976). The effects of Lake Ontario are therefore observed in the harbour.

Burlington Canal

A summary of significant spectral periods in Burlington Canal is presented in Table 9. The 12.0, 5.2 and 3.2 h were the most predominant periodicities observed at locations 1117, 1116 and 1101 for all monthly data sets and in both major directions. The semi-diurnal periodicities may be due to the tidal motions. The 5.2 h and 3.2 h are the first and second modes of free oscillations of

Lake Ontario (Rao and Schwab, 1974 and Palmer and Poulton, 1976). At the bottom location 1102 in Burlington Canal, longer periods of 24.0, 20.0 and 10.9 h were observed. The periodicities of the Burlington Canal indicate that the currents are largely affected by tidal motions and first and second modes of free oscillations of Lake Ontario.

Summary of 95% significant coherences is presented in Table 10 for Burlington Canal water movements and temperatures at 3 levels (locations 1101, 1116 and 1117) during June to August 1976. Significant coherences between current speed and water temperatures at the same location were generally present between 2.0 and 17.1 h. Current speed between two locations exhibited coherences from 12.0 to 30.0 h. Coherence for water temperature between two levels ranged from 2.3 to 24.0 h. These significant coherences between water currents and temperatures at any two levels indicate the vertical cross-correlations of currents and temperature in Burlington Canal during June to August 1976. It is not known if such vertical homogeneity of currents and water temperature existed during the same period of other years.

Desjardins Canal

Table 11 summarizes the major spectral periods in Desjardins Canal from June to November 1976. The most commonly occurring periodicities in this canal are 12.0, 5.2 and 3.2 h. The 12.0 h period is due to the tidal motions. The other two periods are the first and second modes of free oscillations of Lake Ontario. In November 1976, a 13.3 h period was observed along the channel direction; this may be due to the lake-wide seiches.

It is interesting to note that the Burlington and Desjardins Canals have similar periodic motions, namely the tidal motions and the first two modes of free oscillations of Lake Ontario. Therefore, the water movements in the two canals were caused by the same phenomena.

WATER TEMPERATURE

Hamilton Harbour

At the mid-harbour location (1104), water temperatures were measured from June to August 1976. The mean water temperatures varied from 17.6 to 19.2°C, progressively increasing from June to August (see Table 12). The standard deviation of the temperature decreased from 1.1°C in June to 0.6°C in August 1976. The minimum recorded temperature during a month increased from 14.3 to 16.7°C, while the maximum recorded temperature during a month remained almost constant at 20°C.

Burlington Canal

Table 13 presents the frequency of occurrence of water temperatures in Burlington Canal during 1976-77. At the top location 1117, mean temperatures varied from 6.6 to 20.9°C with standard deviations ranging between 1.4 and 2.4°C from June to November 1976. At the next location down (1116), from May to August 1976 and 1977, the mean temperature ranged between 15.2 and 19.7°C, with the standard deviations from 1.4 to 2.3°C. The mean temperature varied from 6.6 to 19.3°C, with the standard deviation ranging from 1.2 to 2.7°C at the mooring 1101, from May to November 1976-77. During June and July 1976, at the lowest site 1101, the mean water temperatures were 11.0 and 9.7°C, with standard deviations of 2.4 and 2.9°C respectively. Figure 5 presents the mean temperature graphs for June and July of 1976 and 1977, at 3 levels. The figure shows a very sharp decline in mean temperature with depth during 1977, compared to the 1976 curve.

Desjardins Canal

Mean water temperature in Desjardins Canal from May to November 76 varied from 4.5 to 20.8°C (see Table 14), while the standard deviations ranged from 1.0 to 3.5°C. The maximum temperature

recorded in the canal was 26.9°C during the study period. As the canal is generally shallow, with a maximum depth of 3.7 m, isothermal conditions are expected to prevail. No bathythermographs were taken to support the assumption of isothermal regime.

CONCLUSIONS

The currents at the mid-harbour location during 1976-77 were similar to those observed during 1975. The resultant currents varied from 0.7 to 1.8 cm.s^{-1} while the arithmetic average speed ranged from 1.7 to 4.8 cm.s^{-1} . In Burlington Canal, the resultant currents varied from 0.6 to 13.4 cm.s^{-1} , while the arithmetic average speed ranged between 6.9 and 16.7 cm.s^{-1} . The maximum speed recorded in Burlington Canal during 1976-77 was 129 cm.s^{-1} . During 1976 the resultant currents in Desjardins Canal varied from 3.3 to 8.1 cm.s^{-1} , while the arithmetic average speed ranged between 9.8 and 24.2 cm.s^{-1} . Both canals exhibited relatively faster currents compared to mid-harbour and lake coastal currents, probably due to the constrictions.

Net flow through Burlington Canal was estimated as 0.2 to 1.4% of the harbour volume per day, while the total exchange through the canal ranged from 1.2 to 1.6% of the harbour volume per day. Net flow through Desjardins Canal to Hamilton Harbour was estimated as 0.02 to 0.05% of the harbour volume per day, while the total exchange through the canal varied from 0.07 to 0.15% of the harbour volume per day. The exchange through the Burlington Canal was an order of magnitude larger than through Desjardins Canal.

Diurnal and semi-diurnal motions were observed at the mid-harbour location. Lake-wide seiches and modes of free oscillations of Lake Ontario were also present, indicating the influence of Lake Ontario at the harbour location. Both Burlington and Desjardins Canals exhibited the semi-diurnal periodicities, as well as the first two modes of free oscillations of Lake Ontario. Thus, the tidal motions and lake effects appear to influence the water movements in the two

canals. Significant coherences were observed from 2 to 30 h between different levels in Burlington Canal during June to August 1976, indicating vertical cross-correlations of currents and water temperatures in the canal.

Mean water temperatures in Hamilton Harbour varied from 17.6 to 19.2°C during June to August 1976. The maximum temperature recorded at this location was 20°C. In Burlington Canal, the mean water temperatures varied from 6.6 to 20.9°C from June to November 1976-77 with the standard deviations of 1.2 to 2.7°C. The Canal had a weak stratification during summer 1976. No stratification was observed in the canal from October to November 1976. In Desjardins Canal, from May to November 1976, the mean temperature varied from 4.5 to 20.8°C, while the standard deviations ranged from 1.0 to 3.5°C. Isothermal regime was assumed in the canal.

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TABLE 1: Current Instrument Operations in Burlington and Desjardins Canals
and Hamilton Harbour, Lake Ontario 1976-77

Location	Location Code	Instrument		Instrument from Bottom (m)	Total Water Depth (m)	Period of Operation	
		Type	No.			From	To
Burlington Canal	1117	P*	239	8.5	9.4	3 Jun 76	23 Aug 76
		P	239	8.5	9.4	2 Oct 76	25 Nov 76
		P	164	8.5	9.4	31 May 77	20 Jul 77
Burlington Canal	1116	P	189	7.5	9.4	3 Jun 76	23 Aug 77
		P	144	7.5	9.4	1 Oct 76	25 Nov 77
		P	206	7.5	9.4	28 May 77	22 Jul 77
Burlington Canal	1101	P	206	6.1	9.4	3 Jun 76	23 Aug 76
		P	206	6.1	9.4	1 Oct 76	25 Nov 76
		P	239	6.1	9.4	28 May 77	22 Jul 77
Burlington Canal	1102	P	207	2.1	9.4	3 Jun 76	10 Jul 76
Hamilton Harbour	1104	G**	038	16.3	22.9	9 Jun 76	23 Aug 76
		G	278	16.3	22.9	28 May 77	27 Aug 77
Desjardins Canal	1109	G	039	1.9	3.7	27 May 76	23 Aug 76
		G	025	1.9	3.7	4 Sep 76	24 Nov 76

* Plessey

** Geodyne

TABLE 2: Statistical Summary of Current Meter Operations
Hamilton Harbour, Lake Ontario, 1976-77

LOCATION CODE 1104

	Jun 76	Jul 76	Aug 76	May 77	Jun 77	Jul 77	Aug 77
Resultant direction coming from 0° as North	24	5	338	52	357	319	345
Resultant speed (cm.s ⁻¹)	0.87	1.77	1.26	0.27	0.67	0.72	0.78
Average speed (cm.s ⁻¹)	4.82	4.60	3.73	2.38	1.67	2.05	2.35
Maximum speed (cm.s ⁻¹)	15	16	10	11	9	28	18
Persistence factor	0.18	0.38	0.34	0.11	0.40	0.35	0.33
Percentage of negligible* speed (% of recording period)	0	0	0	17	25	17	11
Percentage of time going in direction of resultant	13	19	21	11	23	21	15
Total number of readings	3168	4463	3241	576	4320	4464	3785
Interval of readings (min)	10	10	10	10	10	10	10

* < 0.30 cm.s⁻¹

TABLE 3: Statistical Summary of Current Meter Operations
Burlington Canal, Lake Ontario, 1976-77

LOCATION CODE 1117

	Jun 76	Jul 76	Aug 76	Oct 76	Nov 76	May 77	Jun 77	Jul 77
Resultant direction coming from 0° as North	257	258	261	255	220	255	259	257
Resultant speed (cm.s ⁻¹)	8.63	11.58	6.77	4.85	0.93	5.11	10.91	13.38
Average speed (cm.s ⁻¹)	13.45	13.69	10.29	12.03	9.83	7.62	13.35	16.72
Maximum speed (cm.s ⁻¹)	83	54	48	75	49	25	68	71
Persistence factor	0.64	0.85	0.66	0.40	0.09	0.67	0.82	0.80
Percentage of negligible* speed (% of recording period)	1	0	0	1	1	0	0	0
Percentage of time going in direction of resultant	69	81	68	56	4	64	80	79
Percentage of time going towards lake	69	81	68	56	45	64	80	79
Mean speed towards lake (cm.s ⁻¹)	18.88	21.31	15.38	18.13	12.68	8.44	19.30	27.43
Percentage of time going towards harbour	20	11	21	28	37	8	11	13
Mean speed towards harbour (cm.s ⁻¹)	11.55	8.74	8.16	14.37	13.74	8.61	9.36	13.07
Total number of readings	4032	4464	3189	4320	3478	144	4320	2749
Interval of readings (min)	10	10	10	10	10	10	10	10

* < 0.30 cm.s⁻¹

TABLE 3 (cont'd.)

LOCATION CODE 1116

	Jun 76	Jul 76	Aug 76	Oct 76	Nov 76	May 77	Jun 77	Jul 77
Resultant direction coming from 0° as North	263	266	265	241	226	250	256	255
Resultant speed (cm.s ⁻¹)	5.01	5.94	3.56	3.66	2.26	4.03	6.80	6.84
Average speed (cm.s ⁻¹)	11.89	9.34	7.78	10.48	10.39	14.73	11.70	13.16
Maximum speed (cm.s ⁻¹)	129	56	48	77	52	116	72	76
Persistence factor	0.42	0.64	0.46	0.35	0.22	0.27	0.58	0.52
Percentage of negligible* speed (% of recording period)	1	5	2	2	1	0	0	0
Percentage of time going in direction of resultant	57	65	54	46	43	51	64	60
Percentage of time going towards lake	57	65	54	46	43	51	64	60
Mean speed towards lake (cm.s ⁻¹)	15.47	14.88	11.96	15.06	16.29	17.96	16.95	18.26
Percentage of time going towards harbour	29	21	24	32	43	31	21	24
Mean speed towards harbour (cm.s ⁻¹)	11.75	8.12	8.45	10.31	11.71	17.63	10.83	12.13
Total number of readings	4032	4404	3239	4464	3528	576	4320	3046
Interval of readings (min)	10	10	10	10	10	10	10	10

* < 0.30 cm.s⁻¹

TABLE 3 (cont'd.)

LOCATION CODE 1101

	Jun 76	Jul 76	Aug 76	Oct 76	Nov 76	May 77	Jun 77	Jul 77
Resultant direction coming from 0° as North	258	261	271	261	259	48	45	44
Resultant speed (cm.s ⁻¹)	0.95	0.61	1.01	2.55	1.55	3.66	7.56	5.54
Average speed (cm.s ⁻¹)	10.48	6.91	7.06	10.73	10.78	14.08	10.78	7.36
Maximum speed (cm.s ⁻¹)	125.98	49.91	44.06	79.02	50.14	110.79	63.98	50.52
Persistence factor	0.09	0.09	0.14	0.24	0.14	0.26	0.70	0.75
Percentage of negligible* speed (% of recording period)	1	4	2	2	1	0	1	10
Percent of time going in direction of resultant	39	41	44	50	47	57	75	76
Percentage of time going towards lake	39	41	44	50	47	30	17	14
Mean speed towards lake (cm.s ⁻¹)	13.75	9.50	9.6	14.28	15.26	18.58	9.55	7.30
Percentage of time going towards harbour	40	40	39	34	40	57	75	76
Mean speed towards harbour (cm.s ⁻¹)	11.28	8.42	8.02	11.49	13.00	16.49	13.89	10.56
Total number of readings	4032	4464	3190	4464	3478	576	4320	3049
Interval of readings (min)	10	10	10	10	10	10	10	10

* < 0.30 cm.s⁻¹

TABLE 3: (cont'd.)

LOCATION CODE 1102

	Jun 76	Jul 76
Resultant direction coming from 0° as North	290	338
Resultant speed	0.54	0.47
Average speed	0.62	0.73
Maximum speed	24.59	2.96
Persistence factor	0.88	0.65
Percentage of negligible* speed (% of recording period)	49	30
Percent of time going in direction of resultant	52	26
Percent of time going towards lake	52	19
Mean speed towards lake (cm.s ⁻¹)	0.76	0.93
Percent of time going towards harbour	6	5
Mean speed towards harbour (cm.s ⁻¹)	0.72	0.43
Total number of readings	4032	1367
Interval of readings (min)	10	10

* < 0.30 cm.s⁻¹

TABLE 4:

Flow Through Burlington Canal, Lake Ontario, 1976

PERIOD	Average Flow Into Harbour			Average Flow Into Lake			Total Exchange			Net Exchange Toward The Lake		
	$\times 10^6$ $m^3.d^{-1}$	$m^3.s^{-1}$	% of Harbour Vol/day	$\times 10^6$ $m^3.d^{-1}$	$m^3.s^{-1}$	% of Harbour Vol/day	$\times 10^6$ $m^3.d^{-1}$	$m^3.s^{-1}$	% of Harbour Vol/day	$\times 10^6$ $m^3.d^{-1}$	$m^3.s^{-1}$	% of Harbour Vol/day
Jun	0.80	9.26	0.29	3.68	42.59	1.31	4.48	51.85	1.60	2.88	33.33	1.02
Jul	0.14	1.62	0.05	3.99	46.18	1.43	4.13	47.80	1.48	3.85	44.56	1.38
Aug	0.37	4.28	0.13	2.72	31.48	0.97	3.09	35.76	1.10	2.35	27.20	0.84
Oct	0.93	10.76	0.33	2.74	31.71	0.99	3.67	42.47	1.32	1.81	20.95	0.66
Nov	1.44	16.67	0.51	1.95	22.57	0.70	3.39	39.24	1.21	0.51	5.90	0.19

TABLE 5:

Comparison of Flow Through Burlington Canal

(Flow $\times 10^6 \text{ m}^3.\text{d}^{-1}$)

Flow through Burlington Canal	Harris et al (1979) (1)	Kohli (1979) 1975 Data (2)	Mean Value of Present Study 1976 Data (3)	Mean of Columns 2&3 (4)	Ratio Col.1/Col.4 (5)
To lake Q_1	6.08	2.04	3.02	2.53	2.4
To harbour Q_2	5.30	0.69	0.74	0.72	7.4
Total $Q = Q_1 + Q_2$	11.38	2.73	3.76	3.25	3.5
Net $q = Q_1 - Q_2$ towards the lake	0.78	1.35	2.28	1.82	0.4

TABLE 6: Statistical Summary of Current Meter Operations,
Desjardins Canal, Hamilton Harbour, Lake Ontario 1976

LOCATION CODE 1109

	May	Jun	Jul	Aug	Sep	Oct	Nov
Resultant direction coming from 00° as North	264	278	269	278	272	273	266
Resultant speed (cm.s ⁻¹)	3.28	4.25	3.56	3.37	13.71	8.05	6.73
Average speed (cm.s ⁻¹)	9.83	21.13	14.27	16.69	24.17	21.76	23.72
Maximum speed (cm.s ⁻¹)	48.57	87.91	69.36	65.48	85.23	79.24	70.25
Persistence factor	0.33	0.20	0.25	0.20	0.57	0.37	0.28
Percentage of negligible* speed (% of recording period)	0	0	0	0	0	0	0
Percentage of time going in direction of resultant	46	41	42	42	33	36	41
Percentage of time going towards Cootes Paradise	46	41	42	42	28	36	41
Mean Speed towards Cootes Paradise (cm.s ⁻¹)	15.63	31.54	22.64	24.84	25.73	35.18	34.00
Percentage of time going toward harbour	31	32	33	33	11	20	25
Mean Speed towards harbour (cm.s ⁻¹)	11.87	25.53	16.24	19.17	24.93	30.0	30.26
Total number of readings	721	4320	4464	3232	3892	4467	3386
Interval of readings (min)	10	10	10	10	10	10	10

* < 0.30 cm.s⁻¹

Cross-sectional Area of Desjardins Canal = 57 m²

TABLE 7:

Flow Through Desjardins Canal, Hamilton Harbour, Lake Ontario, 1976

Period 1976	Average Flow Into Cootes Paradise			Average Flow Into Harbour			Total Exchange			Net Exchange Towards Harbour		
	$\times 10^6$ $\text{m}^3 \cdot \text{d}^{-1}$	$\text{m}^3 \cdot \text{s}^{-1}$	% of Harbour Vol/day	$\times 10^6$ $\text{m}^3 \cdot \text{d}^{-1}$	$\text{m}^3 \cdot \text{s}^{-1}$	% of Harbour Vol/day	$\times 10^6$ $\text{m}^3 \cdot \text{d}^{-1}$	$\text{m}^3 \cdot \text{s}^{-1}$	% of Harbour Vol/day	$\times 10^6$ $\text{m}^3 \cdot \text{d}^{-1}$	$\text{m}^3 \cdot \text{s}^{-1}$	% of Harbour Vol/day
May	0.07	0.84	0.03	0.14	1.64	0.05	0.21	2.48	0.08	0.07	0.80	0.02
Jun	0.16	1.87	0.06	0.26	2.95	0.09	0.42	4.82	0.15	0.10	1.08	0.03
Jul	0.11	1.22	0.04	0.19	2.17	0.07	0.30	3.39	0.11	0.08	0.95	0.03
Aug	0.12	1.45	0.04	0.21	2.38	0.08	0.33	3.83	0.12	0.09	0.93	0.04
Sep	0.06	0.63	0.02	0.14	1.65	0.05	0.20	2.28	0.07	0.08	1.02	0.03
Oct	0.12	1.37	0.04	0.25	2.89	0.09	0.37	4.26	0.13	0.13	1.52	0.05
Nov	0.15	1.73	0.05	0.27	3.18	0.10	0.42	4.91	0.15	0.12	1.45	0.05

TABLE 8: Summary of Major Spectral Periods (Hours)
Hamilton Harbour, Lake Ontario, 1976-77

(95 Percent Confidence Level)

LOCATION	PERIOD	NORTH-SOUTH	EAST-WEST
1104	Jun 76	12.0*	None
	Jul 76	None	24.0, 12.0, 6.0*
	Aug 76	17.1*, 6.0*, 4.8*, 4.3*	None
	Jun 77	20.0, 10.0*, 3.4*	4.6*, 3.6*
	Jul 77	12.0	None
	Aug 77	None	13.3*

* 80 Percent confidence level

TABLE 9: Summary of Major Spectral Periods (Hours)
Burlington Canal, Lake Ontario 1976-77

(95% Confidence Level)

LOCATION	PERIOD	ALONG CHANNEL	ACROSS CHANNEL
1117	Jun 76	12.0, 5.2, 3.2	12.0, 5.2, 3.2
	Jul 76	12.0, 5.2, 3.2*	12.0, 5.2
	Aug 76	5.2, 3.2*	12.0, 5.2, 3.2
	Oct 76	12.0*, 5.2, 3.2	12.0, 5.2, 3.2
	Nov 76	12.0, 5.2, 3.4*	12.0, 5.2, 3.5*
	Jun 77	12.0, 5.2, 3.2	12.0, 5.2, 3.2
	Jul 77	12.0, 5.2, 3.4	12.0, 5.2, 3.4
1116	Jun 76	12.0*, 5.0, 3.2*	12.0*, 5.2, 3.2*
	Jul 76	12.0, 5.2	12.0, 5.2, 3.2*
	Aug 76	12.0, 5.2, 3.2*	12.0, 5.2, 3.2*
	Oct 76	12.0, 5.2, 3.2	12.0, 5.2, 3.2
	Nov 76	12.0, 5.2, 3.2*	12.0, 6.7*, 5.2, 3.4*
	Jun 77	20.0*, 12.0, 8.0*, 5.2*, 3.2	12.0*, 8.0*, 5.5*, 3.2*
	Jul 77	13.3, 5.2	20.0*, 12.0*, 5.5*
1101	Jun 76	12.0*, 5.2, 3.2*	12.0*, 12.0*, 5.5*
	Jul 76	12.0, 5.2, 3.2*	12.0, 5.2
	Aug 76	12.0, 5.2, 3.2*	12.0, 5.2, 3.2*
	Oct 76	12.0, 5.2, 3.2*	12.0*, 5.2, 3.2*
	Nov 76	12.0, 5.2, 3.2*	12.0, 5.2, 3.2*
	Jun 77	12.0*, 6.0*, 5.2	12.0, 5.2
	Jul 77	12.0*	12.0*, 5.2*
1102	Jun 76	5.2*, 4.8	5.2*
	Jul 76	20.0*	24.0*, 10.9*

* 80 Percent Confidence Level

TABLE 10:

Summary of Coherences (95% Confidence) Burlington Canal, Lake Ontario, 1976

(Hours)

Location #1 Location #2	JUNE		JULY		AUGUST	
	1116 1117	1101 1117	1116 1117	1101 1117	1116 1117	1101 1117
Speed along the canal and Water Temp. at #2	2.0, 2.7 to 6.0, 10.9 to 13.3, 17.1	2.7 to 3.4, 3.7 to 7.1, 9.2 to 17.1	2.9 to 3.2, 3.7 to 4.0, 4.3 to 6.3, 7.1, 10.9 to 17.1	2.4, 2.9 to 3.3, 3.6 to 6.3, 8.6 to 9.2, 0.9 to 17.1	2.1, 3.0-3.2, 4.0, 4.3, 4.4	2.2, 2.7 to 2.9, 3.4, 3.9 to 4.6, 5.0 to 6.3, 15.0
Speed across the canal and Water Temp. at #2	2.0, 2.7 to 6.0, 9.2, 10.9 to 13.3	2.7 to 3.3, 3.7 to 6.0, 6.7 to 7.1, 10.9 to 13.3, 17.1	2.3, 2.9 to 3.3, 3.7 to 4.0, 4.3 to 6.0, 7.1, 10.9 to 17.1	2.4, 2.9 to 3.3, 3.6 to 5.7, 8.6 to 9.2, 10.9 to 15.0	2.1, 3.0 to 3.2, 4.0, 4.4, 5.7	2.2, 2.6, 3.9 to 4.1, 4.4, 5.2 to 6.3, 7.5 to 8.5
Speed along the canal and Water Temp. at #1	3.1 to 3.3, 4.0 to 5.7, 7.1, 12.0 to 17.1	3.1 to 3.4, 4.0 to 5.7, 7.1, 12.0 to 17.1	2.3, 2.6, 2.7 to 2.9, 3.7 to 4.0, 4.4 to 5.0, 6.0, 7.1, 15.0 to 20.0	2.3, 2.6, 2.7 to 2.9, 4.0, 4.4 to 5.0, 6.0, 7.1, 15.0 to 20.0	2.9 to 3.1, 4.8 to 5.2, 6.0 to 6.3, 17.1	3.0, 3.1, 4.8 to 5.2, 6.0 to 6.3, 17.1
Speed across the canal and Water Temp. at #1	3.0 to 3.3, 3.9 to 6.0, 7.1, 12.0 to 17.1	3.1 to 3.3, 3.9 to 6.0, 7.1, 12.0 to 17.1	2.7 to 2.9, 3.9, 4.4 to 5.0, 5.7 to 6.0, 7.1, 13.3 to 17.1	2.7 to 2.9, 3.9, 4.4 to 5.0, 5.7 to 6.0, 7.1, 13.3 to 17.1	3.0, 3.1, 4.8 to 5.2, 6.0 to 6.3, 17.1	3.0, 3.1, 4.8 to 5.2, 6.0 to 6.3, 17.1
Speed along the canal at #2 and #1	2.1 to 8.0, 9.2, 10.9 to 15.0	2.1 to 6.7, 7.5, 10.4 to 13.3	2.2 to 9.2, 10.9 to 30.0	2.0 to 2.6, 2.7 to 6.7, 8.0 to 9.2, 10.9 to 13.3, 24.0	2.0 to 2.3, 2.7 to 9.2, 10.9 to 15.0, 24.0	2.2, 2.7 to 13.3
Speed across the canal at #2 and #1	2.2 to 8.0, 10.9 to 13.3	2.3 to 6.0, 7.5, 10.9 to 13.3	2.2, 2.3 to 9.2, 10.9 to 13.3, 20.0 to 30.0	2.0 to 2.5, 2.8 to 6.7, 10.9 to 13.3	2.1, 2.2, 2.7 to 6.3, 10.9 to 17.1	2.0, 2.2, 2.7 to 13.3
Water Temp.* at #2 and #1	2.3 to 120.0	2.3, 2.8, 3.0 to 7.1, 9.2 to 13.3	3.2, 3.9 to 4.8, 5.5 to 6.7, 10.0 to 24.0	4.0 to 4.8, 5.2 to 6.0, 17.1 to 20.0	2.7, 2.8, 3.0 to 3.2, 3.5, 3.6, 5.5, 7.1 to 7.5, 10.0 to 13.3	7.1 to 7.5

* Water temperature less its grand mean.

TABLE 11: Summary of Major Spectral Periods (Hours)
 Desjardin Canal,
 Hamilton Harbour, Lake Ontario 1976

(95% Confidence Level)

LOCATION	PERIOD	ALONG CHANNEL	ACROSS CHANNEL
1109	Jun 76	12.0, 5.0	12.0, 5.0
	Jul 76	12.0, 5.2	12.0, 6.0*, 5.2, 3.2*
	Aug 76	12.0, 5.2, 3.2*	12.0, 5.2, 3.5*, 3.2
	Sep 76	12.0*, 6.3*, 4.8	12.0*, 5.2
	Oct 76	12.0, 5.2, 3.3*	12.0, 5.2, 3.3*
	Nov 76	13.3*, 5.2	12.0, 5.2

* 80 Percent Confidence Level

TABLE 12: Temperature Frequency,
Hamilton Harbour, Lake Ontario 1976
Percentage of Occurrence
Location Code 1104

Temperature Range °C	Jun 76	Jul 76	Aug 76
14.0 - 14.9	3.05		
15.0 - 15.9	6.68	0.14	
16.0 - 16.9	11.45	16.78	0.19
17.0 - 17.9	43.51	53.59	4.89
18.0 - 18.9	26.15	23.41	29.32
19.0 - 19.9	8.97	6.09	61.28
20.0 - 20.9	0.19		4.32
TOTAL	100.0	100.0	100.0
Mean °C	17.61	17.67	19.16
Std. Dev. °C	1.08	0.74	0.57
Minimum °C	14.28	15.64	16.74
Maximum °C	20.17	19.82	20.31
Series Length (h)	528	743	540

TABLE 13:

Temperature Frequency, Burlington Canal, Lake Ontario, 1976-77

Percentage of Occurrence

Temperature Range °C	L O C A T I O N										
	1 1 1 7					1 1 1 6					
	P E R I O D										
	Jun 76	Jul 76	Aug 76	Oct 76	Nov 76	Jun 76	Jul 76	Aug 76	May 77	Jun 77	Jul 77
3.0- 3.9					1.04						
4.0- 4.9					19.13						
5.0- 5.9				0.28	19.13						
6.0- 6.9				0.56	20.70				1.05		
7.0- 7.9				1.97	16.17	0.30			0.00		
8.0- 8.9				4.65	13.04	0.00			0.00		0.20
9.0- 9.9				14.79	9.91	0.15			1.05		0.00
10.0-10.9	0.30			13.94	0.87	0.30	0.14		4.21		0.00
11.0-11.9	0.61			6.20		0.45	0.00		7.37		0.20
12.0-12.9	0.15			11.13		2.56	0.00		3.16	0.14	0.00
13.0-13.9	0.76			11.13		5.86	0.27		5.26	0.84	0.40
14.0-14.9	2.42			19.44		8.12	1.09		18.95	2.38	0.99
15.0-15.9	7.26			13.24		9.32	5.70	0.37	35.79	17.95	2.19
16.0-16.9	6.20	1.90	0.95	2.68		13.68	10.45	2.06	2.11	23.70	7.75
17.0-17.9	10.29	3.39	3.80			18.05	22.25	9.72	3.16	15.71	11.53
18.0-18.9	13.16	11.94	8.56			18.35	24.69	21.68	5.26	9.82	14.31
19.0-19.9	22.09	21.17	15.40			12.18	24.97	22.06	9.47	14.03	14.91
20.0-20.9	18.76	33.24	20.34			8.57	8.68	29.16	3.16	9.54	15.71
21.0-21.9	14.07	19.95	31.94			2.11	1.63	9.91		4.35	18.89
22.0-22.9	3.93	5.29	8.37				0.14	4.86		1.54	9.15
23.0-23.9		3.12	5.89					0.19			2.78
24.0-24.9			4.37								0.99
25.0-100.0			0.38								
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean °C	19.02	20.29	20.90	12.35	6.62	17.25	18.29	19.66	15.22	17.68	19.63
St. Dev. °C	2.16	1.36	1.66	2.44	1.63	2.26	1.48	1.38	2.64	1.95	2.16
Minimum °C	10.41	16.18	16.78	5.96	3.82	7.16	10.04	15.65	6.85	12.45	8.60
Maximum °C	22.87	23.74	25.20	16.98	10.23	21.63	22.20	23.03	20.80	22.99	24.65
Series Length (h)	672	744	531	720	579	672	744	539	96	720	507

TABLE 13: (cont'd)

Percentage of Occurrence

Temperature Range °C	L O C A T I O N									
	1 1 0 1								1 1 0 2	
	P E R I O D									
	Jun 76	Jul 76	Aug 76	Oct 76	Nov 76	May 77	Jun 77	Jul 77	Jun 76	Jul 76
3.0- 3.9					0.87					
4.0- 4.9					17.57					
5.0- 5.9				0.14	19.13		0.28	1.79		3.11
6.0- 6.9				1.36	23.65	5.26	3.65	9.16	2.87	9.78
7.0- 7.9	0.30			2.99	16.87	9.47	15.43	11.16	10.11	17.78
8.0- 8.9	0.15	0.14		5.83	12.87	6.32	23.98	16.93	11.01	17.78
9.0- 9.9	0.30	0.14		15.74	8.17	17.89	22.58	14.54	10.26	20.89
10.0-10.9	0.60	0.27		12.08	0.87	10.53	9.82	15.74	16.74	11.11
11.0-11.9	2.39	0.54		7.46		15.79	7.15	8.17	13.27	3.11
12.0-12.9	3.59	1.09		12.08		14.74	7.15	3.98	12.67	3.56
13.0-13.9	8.37	4.07		14.79		16.84	4.35	2.79	9.20	2.22
14.0-14.9	11.06	10.85		22.66		3.16	3.23	8.96	10.26	0.44
15.0-15.9	17.49	15.20	0.19	4.48			1.54	3.98	2.41	1.33
16.0-16.9	18.98	25.24	1.73	0.41			0.56	2.39	0.45	7.11
17.0-17.9	19.58	24.15	13.85				0.14	0.20	0.15	0.89
18.0-18.9	8.52	10.99	25.19				0.14	0.00	0.30	0.00
19.0-19.9	4.78	5.97	29.42					0.20	0.30	0.89
20.0-20.9	3.14	1.36	22.12							
21.0-21.9	0.75		7.12							
22.0-22.9			0.38							
23.0-23.9										
24.0-24.9										
25.0-25.9										
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean °C	16.16	16.57	19.25	11.99	6.62	10.75	9.76	10.20	11.03	9.69
Std. Dev. °C	2.16	1.69	1.20	2.34	1.54	2.17	2.16	2.74	2.42	2.94
Minimum °C	7.44	8.90	15.38	5.98	3.90	6.41	5.88	5.04	6.33	5.53
Maximum °C	21.49	20.58	22.13	16.33	10.29	14.21	18.36	19.55	19.43	19.38
Series Length (h)	672	744	531	744	579	96	720	508	672	227

TABLE 14: Temperature Frequency, Desjardins Canal Hamilton Harbour,
Lake Ontario 1976
Percentage of Occurrence

Temperature Range °C	May 76	Jun 76	Jul 76	Sep 76	Oct 76	Nov 76
0.0 - 0.9						2.68
1.0 - 1.9						6.26
2.0 - 2.9					0.94	9.48
3.0 - 3.9					0.94	19.32
4.0 - 4.9					1.75	22.36
5.0 - 5.9					3.51	18.96
6.0 - 6.9					7.96	11.27
7.0 - 7.9			0.14		8.10	7.87
8.0 - 8.9		0.28	0.00		8.64	1.79
9.0 - 9.9		0.00	0.00		6.34	
10.0 - 10.9		0.00	0.00		8.37	
11.0 - 11.9		0.70	0.00	0.16	9.85	
12.0 - 12.9		0.42	0.54	3.89	11.74	
13.0 - 13.9		0.56	0.14	12.31	6.88	
14.0 - 14.9	1.69	1.26	2.71	13.86	9.18	
15.0 - 15.9	7.63	4.63	3.39	7.01	9.04	
16.0 - 16.9	6.78	9.55	6.50	4.98	6.07	
17.0 - 17.9	43.22	12.22	10.57	13.24	0.67	
18.0 - 18.9	37.29	14.61	11.92	19.16		
19.0 - 19.9	2.54	16.25	14.09	16.98		
20.0 - 20.9	0.85	19.52	10.57	7.17		
21.0 - 21.9		7.87	10.30	1.25		
22.0 - 22.9		7.30	4.61			
23.0 - 23.9		1.83	1.63			
24.0 - 24.9		0.28	0.41			
25.0 - 25.9		0.14	0.14			
26.0 - 26.9		2.67	22.36			
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Mean °C	17.68	19.29	20.84	16.95	11.07	4.54
Std. Dev. °C	0.99	2.59	3.81	2.44	3.47	1.76
Minimum °C	14.67	8.15	7.00	11.77	2.28	0.12
Maximum °C	20.12	26.90	26.90	21.44	17.47	8.50
Series Length (h)	120	720	744	648	744	564

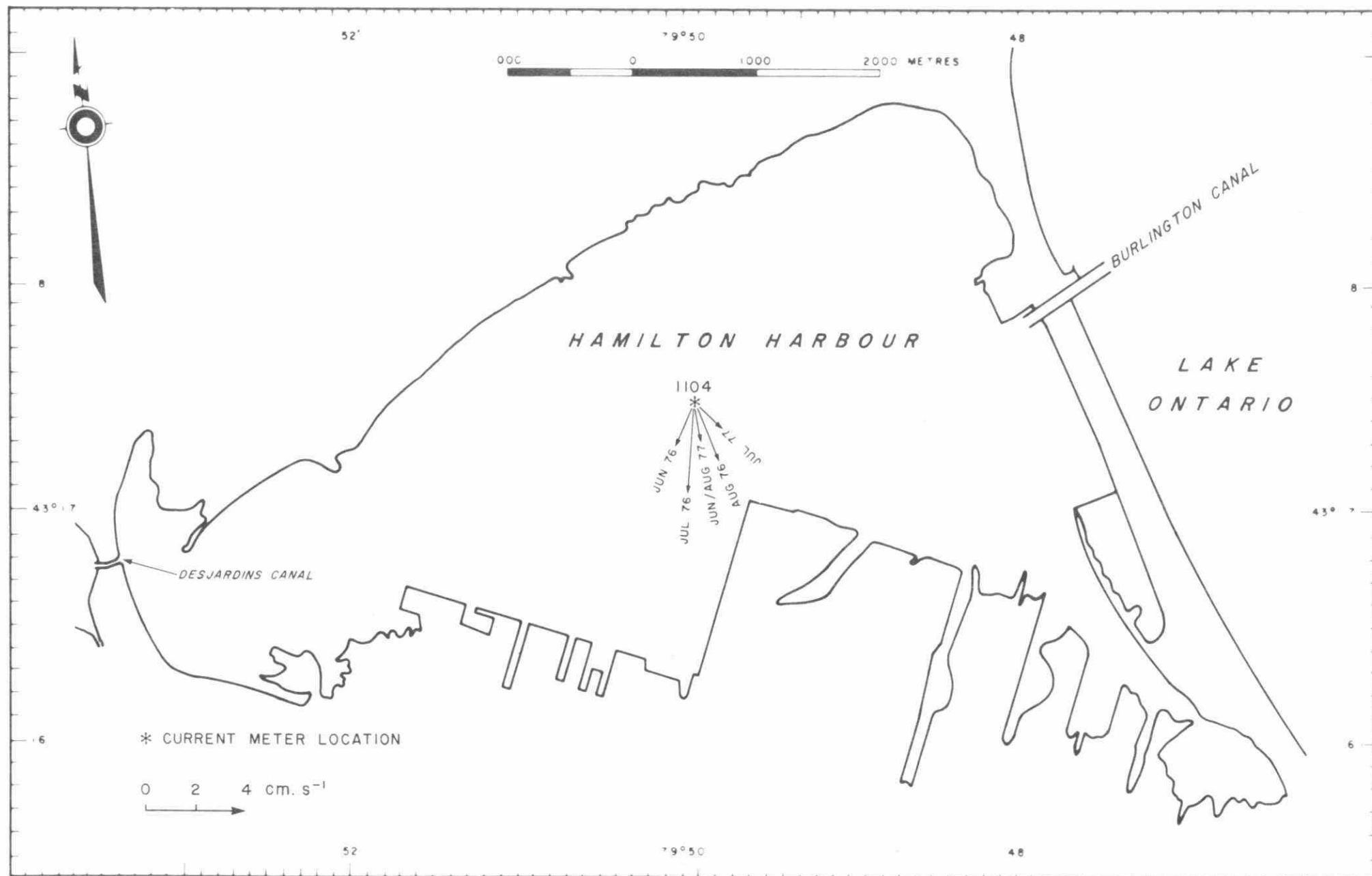


FIGURE 1 - RESULTANT CURRENTS IN HAMILTON HARBOUR, LAKE ONTARIO, 1976-77.

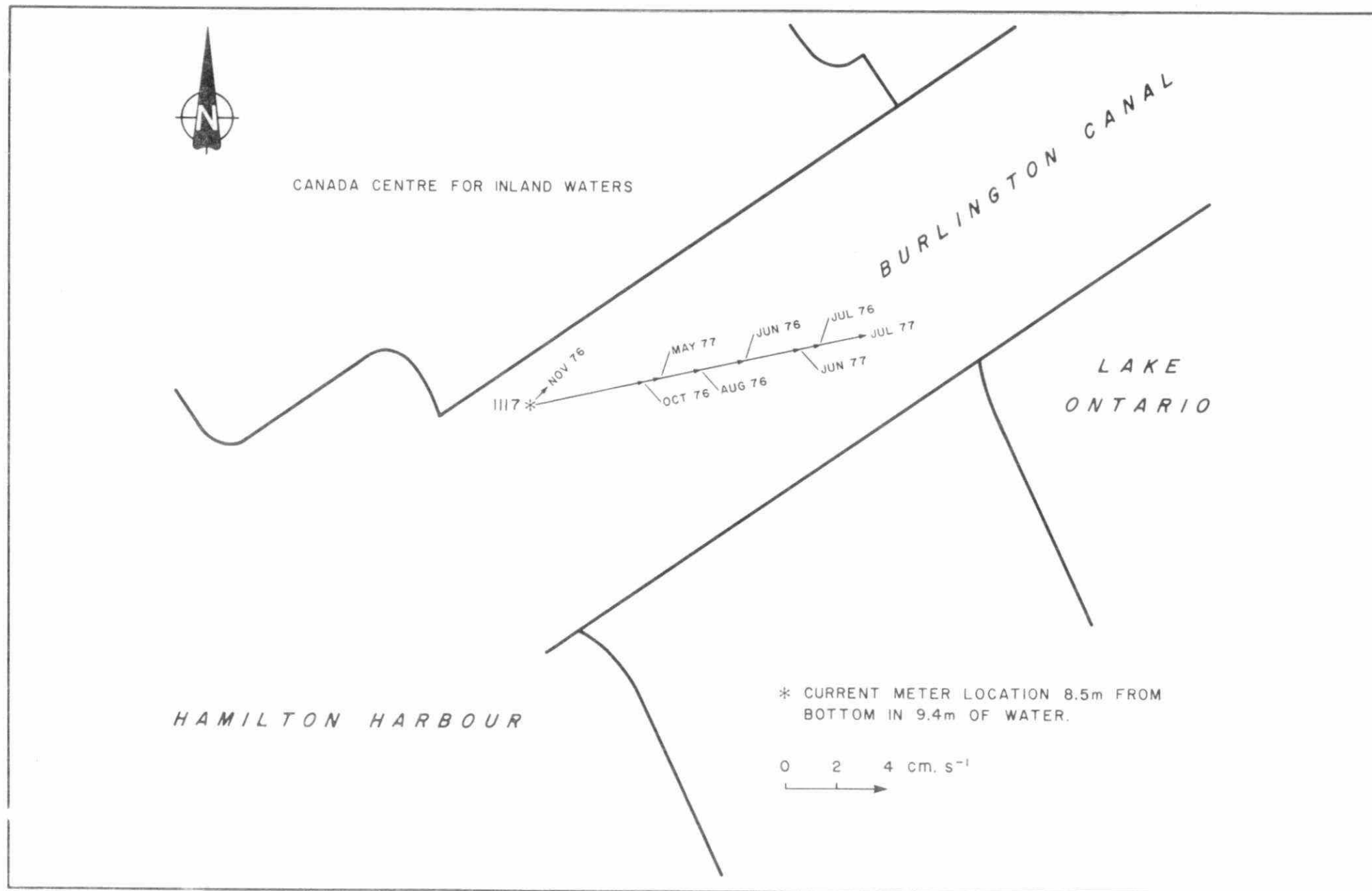


FIGURE 2 - RESULTANT CURRENTS IN BURLINGTON CANAL, LAKE ONTARIO, 1976-77.

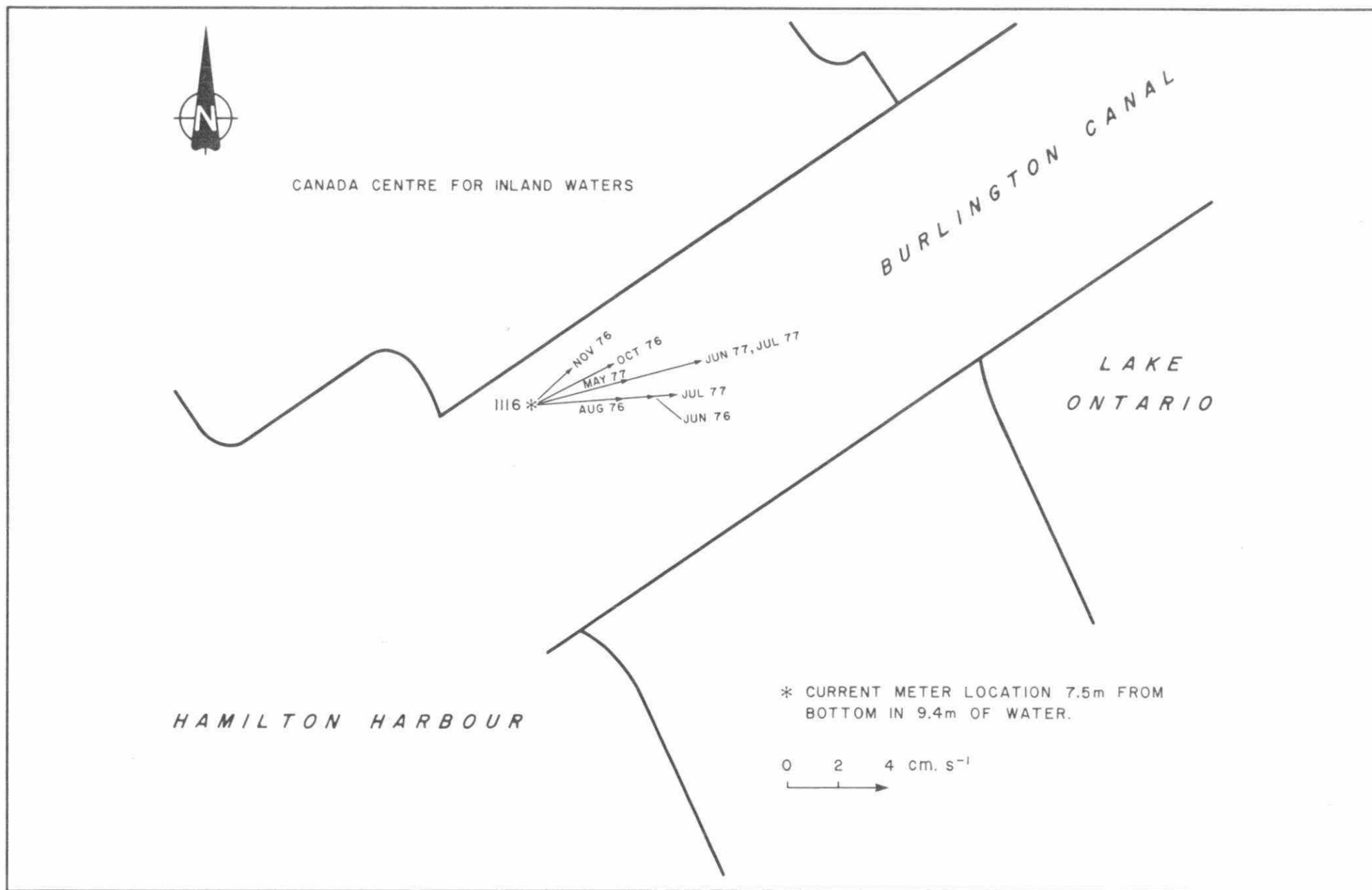


FIGURE 3 - RESULTANT CURRENTS IN BURLINGTON CANAL, LAKE ONTARIO, 1976-77.

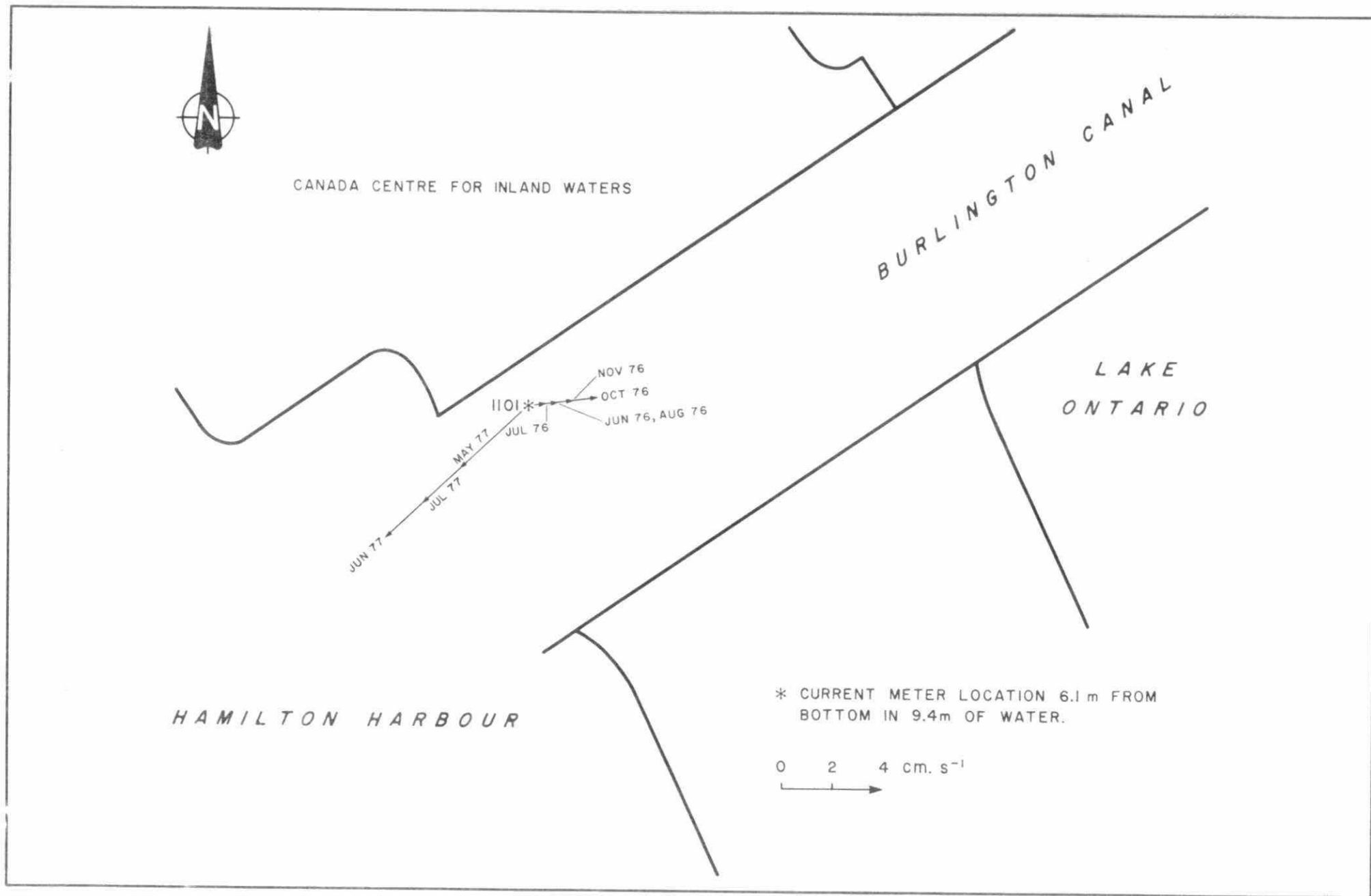


FIGURE 4 - RESULTANT CURRENTS IN BURLINGTON CANAL, LAKE ONTARIO, 1976-77.

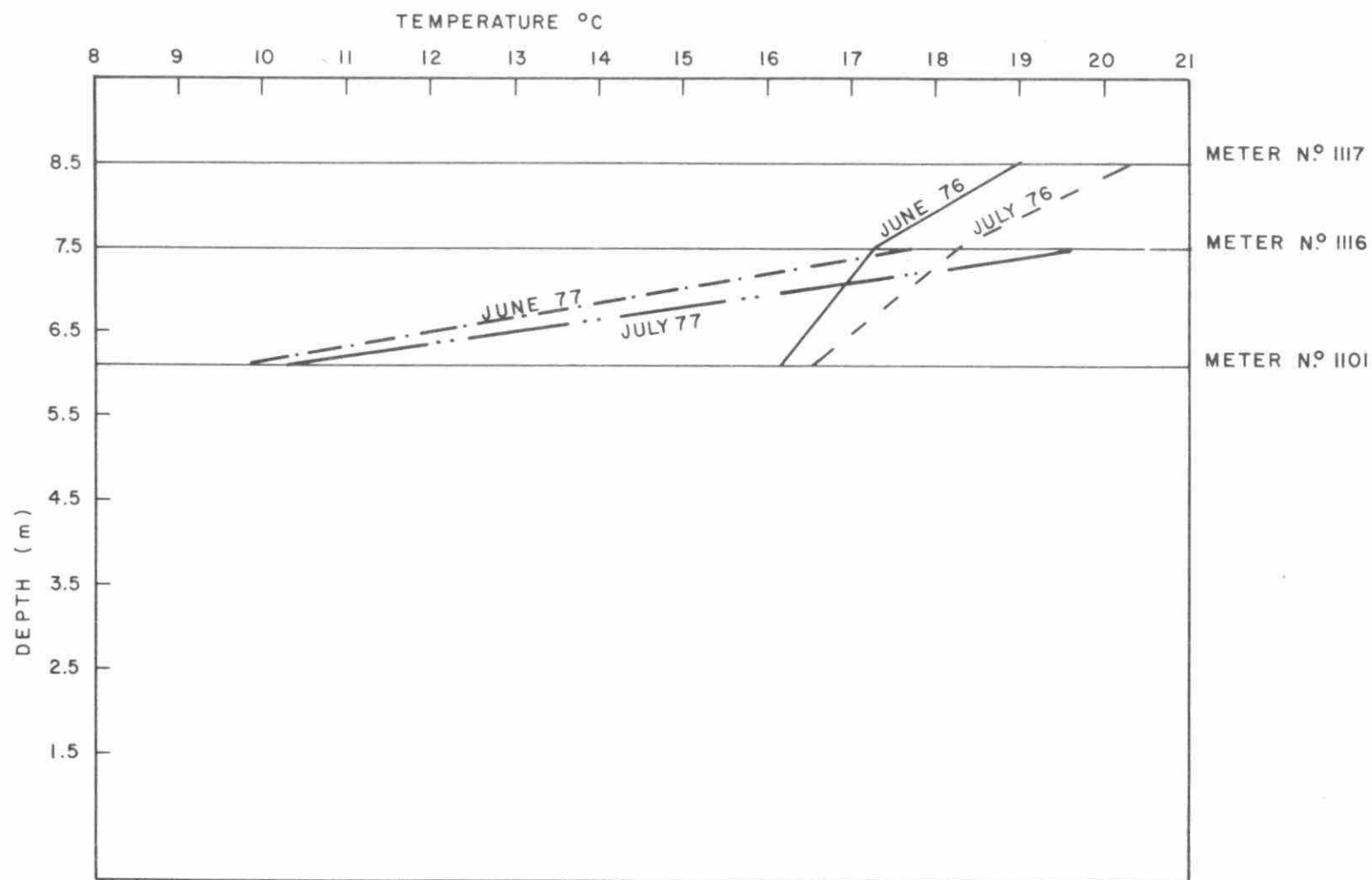


FIGURE 5 - MEAN TEMPERATURE IN BURLINGTON CANAL, HAMILTON HARBOUR, LAKE ONTARIO, 1976-77.

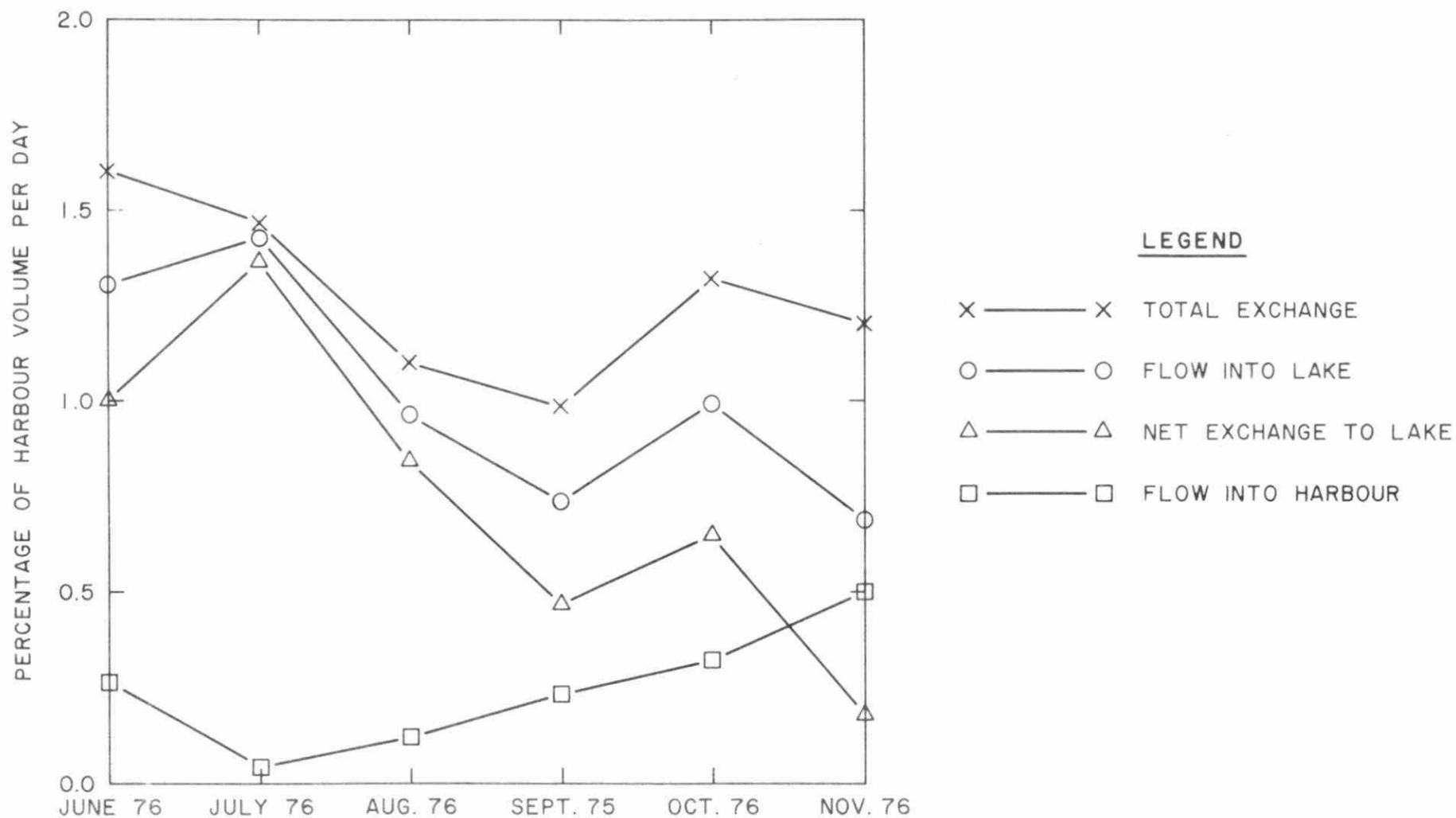


FIGURE 6 - EXCHANGE THROUGH BURLINGTON CANAL, LAKE ONTARIO, 1975-76.

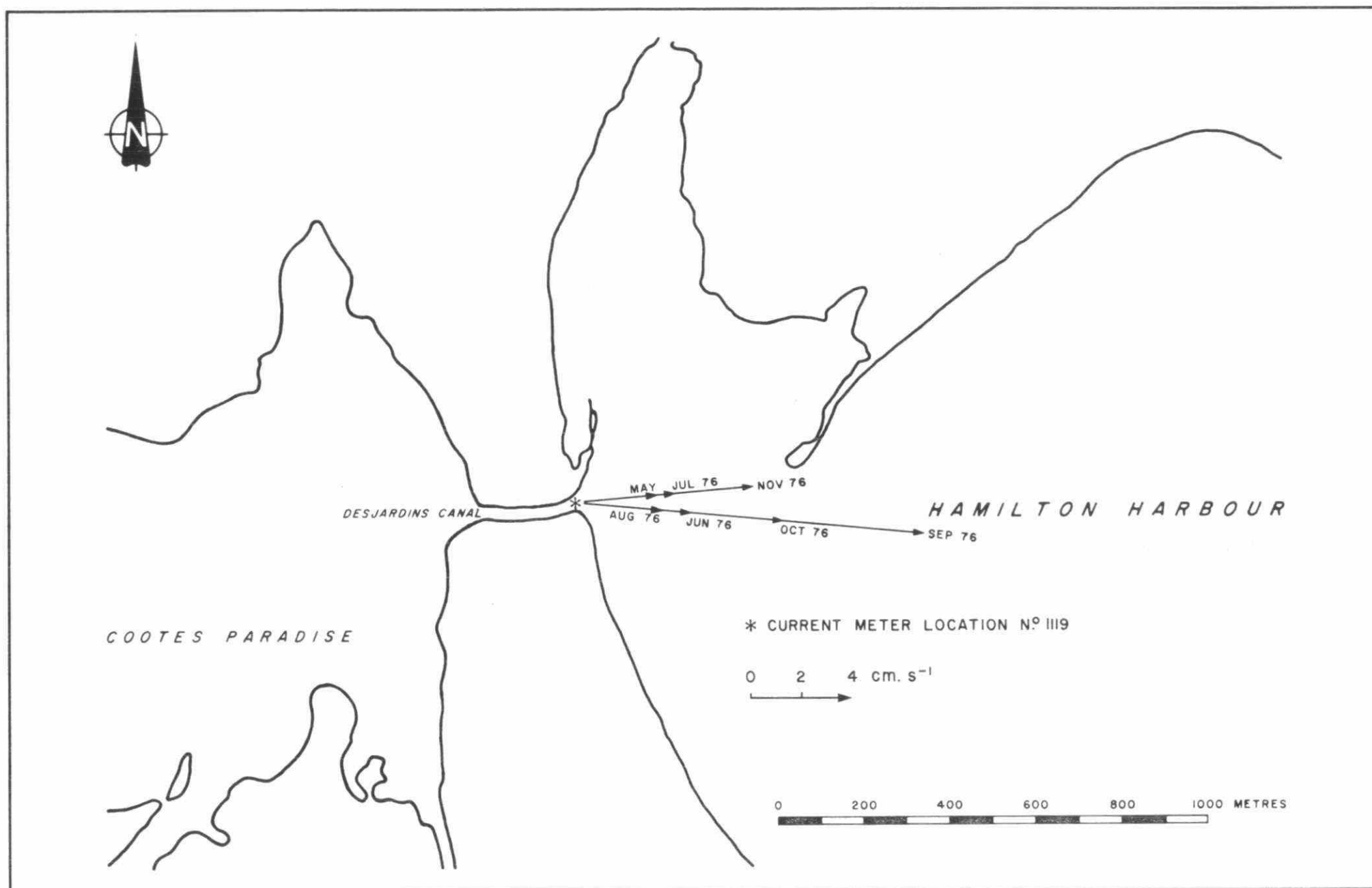


FIGURE 7 - RESULTANT CURRENTS IN DESJARDINS CANAL, HAMILTON HARBOUR, LAKE ONTARIO, 1976.

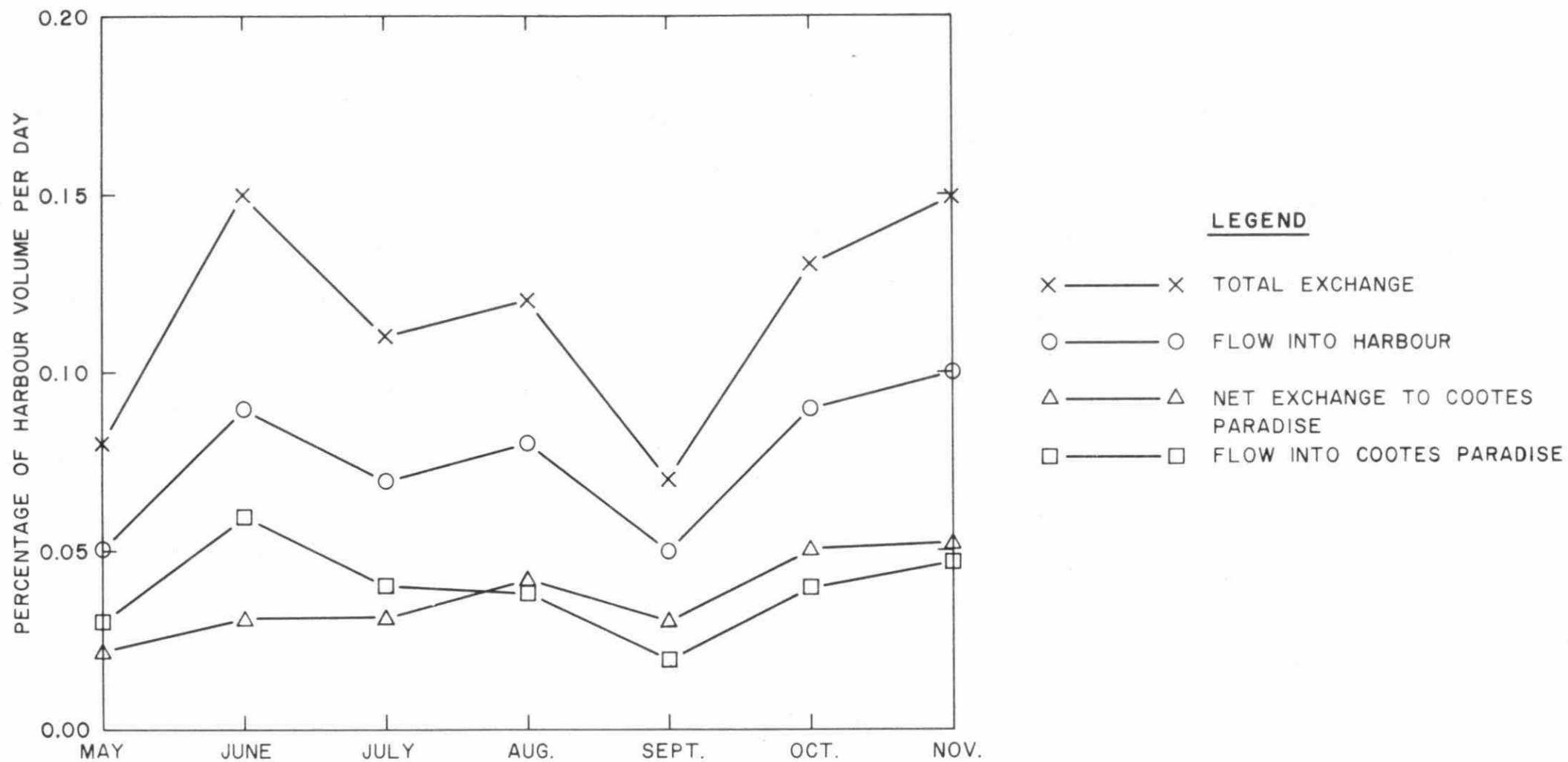


FIGURE 8 - EXCHANGE THROUGH DESJARDINS CANAL, HAMILTON HARBOUR, LAKE ONTARIO, 1976.

APPENDIX 1
HAMILTON HARBOUR WATER MOVEMENTS

DATA ANALYSIS

All data collected during the current meter operations of 1976-77 were pre-whitened or numerically smoothed (Blackman and Tukey, 1959; p. 29, 39, 74) using binominal weights suggested by Panofsky and Brier (1968; p. 150). Current speed and direction and water temperature data are smoothed (Kohli, 1978). If the instrument was operated in Burlington or Desjardins Canals, the direction was not smoothed, as the water movements in the channel are essentially along the channel axis.

The smoothed data are divided into monthly records to facilitate comparison of results to previous and other studies, as well as to provide a manageable dataset length. For each dataset, a two-dimensional frequency of occurrence of current speed and direction were computed along with the resultant speed and direction, arithmetic mean and maximum current speeds and the persistence factor. The current frequency tables along with the above statistics are presented in Tables 1.01 to 1.40.

The current time series (dataset) were resolved along the north-south and east-west components. In case of Burlington and Desjardins Canals, the currents were resolved along and across the channel axis. The resolved currents were then averaged over an hour. The hourly average current components were then subjected to spectral analysis (Kohli, 1978) to obtain the major significant spectral periods. Comparison of these with the theoretical periods of time variation helps to understand the physics underlying such variations. The concurrent data sets at the two locations in Burlington Canal were subjected to cross-correlations and coherence analysis to determine the significant periods of coherence between the two data sets. Coherence is a measure of the goodness of relationship between the two variable series for different periods. Coherences can lie between 0 and 1, and is analogous to the square of the correlation coefficient, except that the coherence is a function of frequency.

REFERENCES

1. Black, R.B. and J.W. Tukey, 1959. The Measurement of Power Spectra. Dover Publications, Inc., New York, 198p.
2. Kohli, B. 1978. Hamilton Harbour Physical Processes. Ontario Ministry of the Environment, Water Resources Branch, Toronto, Ontario. 53p.
3. Panofsky, H.A. and G.W. Brier, 1968. Some Applications of Statistics to Meteorology. The Pennsylvania State University, University Park, Pennsylvania. 224p.

TABLE 1.01

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUN 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.0	0.02	0.27	0.0	0.0	0.02	0.79	0.0	1.12	
0.31 -- 4.99	0.92	1.24	6.10	0.40	0.17	1.07	8.43	1.02	19.35	
5.00 -- 9.99	0.35	1.22	6.18	0.17	0.30	0.97	14.81	0.77	24.75	
10.00 -- 14.99	0.17	0.47	3.70	0.05	0.05	0.37	14.73	0.17	19.72	
15.00 -- 19.99	0.0	0.10	1.93	0.05	0.0	0.20	11.71	0.0	13.99	
20.00 -- 24.99	0.0	0.05	0.69	0.02	0.02	0.12	6.99	0.0	7.91	
25.00 -- 82.99	0.0	0.02	1.41	0.0	0.0	0.17	11.53	0.02	13.17	
COLUMN SUMS	1.44	3.12	20.29	0.69	0.55	2.93	69.00	1.98	100.00	

RESULTANT CURRENT IS 8.63 CM/S AT 257 DEG FROM NORTH
 MEAN CURRENT IS 13.45 CM/S
 MAXIMUM CURRENT IS 82.89 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4032
 PERSISTENCE IS 0.64
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 3 TH DAY OF 6 TH MONTH 1976
 ENDED AT 23.58 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE 1.02

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES											
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-			
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS		
0.0 -- 0.30	0.02	0.02	0.13	0.0	0.0	0.0	0.11	0.04	0.34		
0.31 -- 2.99	0.07	0.69	1.93	0.31	0.09	0.38	3.36	0.90	7.73		
3.00 -- 5.99	0.34	0.56	2.87	0.13	0.13	0.47	8.00	0.65	13.15		
6.00 -- 8.99	0.07	0.20	2.55	0.09	0.11	0.43	9.77	0.11	13.33		
9.00 -- 11.99	0.09	0.20	1.88	0.09	0.09	0.38	9.90	0.16	12.79		
12.00 -- 14.99	0.09	0.09	0.83	0.0	0.02	0.09	11.29	0.04	12.46		
15.00 -- 54.99	0.04	0.11	0.87	0.0	0.02	0.18	38.96	0.02	40.21		
COLUMN SUMS	0.72	1.88	11.07	0.63	0.47	1.93	81.38	1.93	100.00		

RESULTANT CURRENT IS 11.58 CM/S AT 258 DEG FROM NORTH
 MEAN CURRENT IS 13.69 CM/S
 MAXIMUM CURRENT IS 54.19 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.85
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 23.57 HRS. ON 31 TH DAY OF 7 TH MONTH 1976

TABLE 1.03

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : AUG 74
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-	ROW SUMS	
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49		
0.0 --	0.30	0.03	0.0	0.0	0.0	0.0	0.06	0.09	0.19	
0.31 --	2.99	0.41	0.88	3.92	0.60	0.13	0.69	4.99	0.66	12.26
3.00 --	5.99	0.47	1.00	6.93	0.78	0.25	0.69	11.01	1.03	22.17
6.00 --	8.99	0.22	0.47	4.42	0.22	0.13	0.47	11.04	0.31	17.28
9.00 --	11.99	0.06	0.03	2.45	0.06	0.0	0.25	11.13	0.06	14.05
12.00 --	14.99	0.0	0.13	1.72	0.0	0.03	0.19	9.22	0.0	11.29
15.00 --	48.99	0.0	0.06	1.63	0.0	0.0	0.16	20.92	0.0	22.77
COLUMN SUMS	1.19	2.57	21.07	1.66	0.53	2.45	68.36	2.16	100.00	

RESULTANT CURRENT IS 6.77 CM/S AT 261 DEG FROM NORTH
 MEAN CURRENT IS 10.29 CM/S
 MAXIMUM CURRENT IS 48.49 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 3189
 PERSISTENCE IS 0.66
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.07 HRS. ON 1 TH DAY OF 8 TH MONTH 1976
 ENDED AT 3.25 HRS. ON 23 TH DAY OF 8 TH MONTH 1976

TABLE 1.04

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : OCT 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.28	0.02	0.16	0.0	0.02	0.07	0.35	0.09	1.00	
0.31 -- 3.99	1.06	0.88	3.52	1.23	0.74	0.97	4.63	1.62	14.65	
4.00 -- 7.99	0.76	0.30	6.55	1.46	0.42	0.62	11.90	1.69	23.70	
8.00 -- 11.99	0.25	0.35	6.16	0.37	0.14	0.42	10.88	0.42	18.98	
12.00 -- 15.99	0.05	0.12	4.98	0.16	0.02	0.42	9.72	0.28	15.74	
16.00 -- 19.99	0.02	0.0	2.75	0.07	0.02	0.21	6.69	0.09	9.86	
20.00 -- 74.99	0.0	0.0	3.59	0.02	0.0	0.30	12.06	0.09	16.06	
COLUMN SUMS	2.43	1.67	27.71	3.31	1.37	3.01	56.23	4.28	100.00	

RESULTANT CURRENT IS 4.85 CM/S AT 255 DEG FROM NORTH
 MEAN CURRENT IS 12.03 CM/S
 MAXIMUM CURRENT IS 74.97 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.40
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 2 TH DAY OF 10 TH MONTH 1976
 ENDED AT 23.58 HRS. ON 31 TH DAY OF 10 TH MONTH 1976

TABLE 1.05

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : NOV 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.03	0.09	0.26	0.14	0.03	0.0	0.14	0.0	0.69
0.31 --	2.99	0.92	1.29	3.57	0.81	1.41	1.06	4.17	0.58	13.80
3.00 --	5.99	0.63	1.27	6.21	1.41	0.78	1.70	10.03	0.72	22.74
6.00 --	8.99	0.32	0.55	7.04	0.69	0.20	0.95	9.92	0.23	19.90
9.00 --	11.99	0.09	0.20	5.89	0.29	0.12	0.29	6.35	0.14	13.37
12.00 --	14.99	0.09	0.09	5.03	0.03	0.0	0.12	5.12	0.06	10.52
15.00 --	49.99	0.03	0.03	8.97	0.09	0.06	0.17	9.63	0.0	18.98
COLUMN SUMS	2.10	3.51	36.98	3.45	2.59	4.28	45.37	1.73	100.00	

RESULTANT CURRENT IS 0.93 CM/S AT 220 DEG FROM NORTH
 MEAN CURRENT IS 9.83 CM/S
 MAXIMUM CURRENT IS 49.39 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 3478
 PERSISTENCE IS 0.09
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M DE WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 11 TH MONTH 1976
 ENDED AT 3.37 HRS. ON 25 TH DAY OF 11 TH MONTH 1976

TABLE 1.06

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : MAY 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.31 --	1.99	0.0	1.39	0.0	0.69	2.78	1.39	4.17	0.69	11.11
2.00 --	3.99	0.69	3.47	2.08	0.0	0.0	2.08	8.33	0.0	16.67
4.00 --	5.99	1.39	0.0	0.69	0.69	0.69	4.17	9.72	0.0	17.36
6.00 --	7.99	0.0	1.39	0.0	0.69	2.08	0.69	8.33	0.0	13.19
8.00 --	9.99	0.0	1.39	1.39	0.0	0.0	1.39	7.64	0.0	11.81
10.00 --	25.99	0.0	0.69	3.47	0.0	0.0	0.0	25.69	0.0	29.86
COLUMN SUMS	2.08	8.33	7.64	2.08	5.56	9.72	63.89	0.69	100.00	

RESULTANT CURRENT IS 5.11 CM/S AT 255 DEG FROM NORTH
 MEAN CURRENT IS 7.62 CM/S
 MAXIMUM CURRENT IS 25.28 CM/S
 MINIMUM CURRENT IS 0.35 CM/S

TOTAL NO. READINGS 144
 PERSISTENCE IS 0.67
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 31 TH DAY OF 5 TH MONTH 1977
 ENDED AT 23.60 HRS. ON 31 TH DAY OF 5 TH MONTH 1977

TABLE 1.07

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUN 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.02	0.0	0.09	0.0	0.07	0.02	0.28	0.0	0.49	
0.31 -- 3.99	0.49	1.41	1.97	0.16	0.16	1.02	6.99	0.53	12.73	
4.00 -- 7.99	0.28	1.18	4.10	0.16	0.09	0.83	11.81	0.19	18.63	
8.00 -- 11.99	0.12	0.49	2.59	0.0	0.09	0.67	14.70	0.12	18.77	
12.00 -- 15.99	0.02	0.14	1.53	0.0	0.0	0.19	14.28	0.05	16.20	
16.00 -- 19.99	0.0	0.05	0.53	0.0	0.0	0.07	11.74	0.0	12.38	
20.00 -- 68.99	0.0	0.05	0.44	0.0	0.0	0.05	20.25	0.0	20.79	
COLUMN SUMS	0.93	3.31	11.25	0.32	0.42	2.85	80.05	0.88	100.00	

RESULTANT CURRENT IS 10.91 CM/S AT 259 DEG FROM NORTH
 MEAN CURRENT IS 13.35 CM/S
 MAXIMUM CURRENT IS 68.49 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.82
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 1 TH DAY OF 6 TH MONTH 1977
 ENDED AT 23.58 HRS. ON 30 TH DAY OF 6 TH MONTH 1977

TABLE 1.08

LOCATION CODE : 1117
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.0	0.0	0.07	0.0	0.0	0.07	0.18	0.0	0.33	
0.31 -- 3.99	0.25	0.33	1.82	0.15	0.25	0.55	3.09	0.11	6.55	
4.00 -- 7.99	0.44	0.84	2.87	0.25	0.15	1.13	8.18	0.51	14.37	
8.00 -- 11.99	0.07	0.73	3.53	0.07	0.15	0.73	10.80	0.22	16.30	
12.00 -- 15.99	0.07	0.18	1.86	0.0	0.04	0.47	11.82	0.0	14.44	
16.00 -- 19.99	0.04	0.07	1.20	0.04	0.11	0.22	12.55	0.07	14.30	
20.00 -- 71.99	0.0	0.04	1.20	0.0	0.0	0.25	32.08	0.15	33.72	
COLUMN SUMS	0.87	2.18	12.55	0.51	0.69	3.42	78.72	1.05	100.00	

RESULTANT CURRENT IS 13.38 CM/S AT 257 DEG FROM NORTH
 MEAN CURRENT IS 16.72 CM/S
 MAXIMUM CURRENT IS 71.11 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 2749
 PERSISTENCE IS 0.80
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 8.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 7 TH MONTH 1977
 ENDED AT 2.17 HRS. ON 20 TH DAY OF 7 TH MONTH 1977

TABLE 1.09

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUN 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.02	0.15	0.07	0.07	0.12	0.15	0.27	0.0	0.87	
0.31 -- 6.99	1.29	1.93	12.03	2.21	0.97	1.91	16.96	1.59	38.89	
7.00 -- 13.99	0.47	0.47	9.37	0.37	0.20	1.04	18.18	0.50	30.61	
14.00 -- 20.99	0.05	0.02	3.60	0.05	0.02	0.27	10.09	0.10	14.21	
21.00 -- 27.99	0.0	0.02	2.06	0.0	0.0	0.05	5.78	0.0	7.91	
28.00 -- 34.99	0.0	0.0	0.92	0.0	0.0	0.0	3.35	0.0	4.27	
35.00 -- 128.99	0.0	0.0	0.67	0.0	0.0	0.05	2.53	0.0	3.25	
COLUMN SUMS	1.84	2.60	28.72	2.70	1.31	3.47	57.17	2.18	100.00	

RESULTANT CURRENT IS 5.01 CM/S AT 263 DEG FROM NORTH
 MEAN CURRENT IS 11.89 CM/S
 MAXIMUM CURRENT IS 128.65 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4032
 PERSISTENCE IS 0.02
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 3 TH DAY OF 6 TH MONTH 1976
 ENDED AT 23.58 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE 1.10

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (LOOKING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.07	0.07	0.81	0.43	0.20	0.34	3.23	0.20	5.33	
0.31 -- 2.99	0.60	1.14	4.70	0.90	0.56	0.83	5.78	0.72	15.23	
3.00 -- 5.99	0.81	0.83	5.76	0.47	0.25	1.28	10.15	1.01	20.54	
6.00 -- 8.99	0.27	0.45	3.70	0.20	0.09	0.56	10.42	0.63	16.31	
9.00 -- 11.99	0.04	0.13	2.71	0.22	0.07	0.36	9.52	0.18	13.24	
12.00 -- 14.99	0.04	0.02	1.39	0.04	0.0	0.16	8.15	0.13	9.95	
15.00 -- 55.99	0.0	0.02	1.68	0.02	0.0	0.20	17.43	0.04	19.40	
COLUMN SUMS	1.84	2.67	20.74	2.28	1.16	3.72	64.67	2.91	100.00	

RESULTANT CURRENT IS 5.94 CM/S AT 266 DEG FROM NORTH
 MEAN CURRENT IS 9.34 CM/S
 MAXIMUM CURRENT IS 55.75 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.64
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 23.57 HRS. ON 31 TH DAY OF 7 TH MONTH 1976

TABLE 1.11

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : AUG 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.31	0.34	0.22	0.12	0.06	0.19	0.37	0.28	1.88
0.31 --	2.99	1.61	1.85	4.91	1.39	1.20	2.44	8.15	1.39	22.94
3.00 --	5.99	0.99	1.27	6.64	0.83	0.56	2.16	10.99	1.17	24.61
6.00 --	8.99	0.22	0.31	5.31	0.34	0.12	0.80	11.24	0.56	18.89
9.00 --	11.99	0.09	0.25	2.99	0.03	0.12	0.56	7.07	0.25	11.36
12.00 --	14.99	0.0	0.0	2.04	0.03	0.0	0.12	4.66	0.03	6.88
15.00 --	48.99	0.03	0.03	2.13	0.0	0.0	0.06	11.15	0.03	13.43
COLUMN SUMS	3.24	4.04	24.24	2.75	2.07	6.33	53.63	3.70	100.00	

RESULTANT CURRENT IS 3.56 CM/S AT 265 DEG FROM NORTH
 MEAN CURRENT IS 7.78 CM/S
 MAXIMUM CURRENT IS 48.45 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 3239
 PERSISTENCE IS 0.46
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M DE WATER

STARTED AT 0.07 HRS. ON 1 TH DAY OF 8 TH MONTH 1976
 ENDED AT 11.45 HRS. ON 23 TH DAY OF 8 TH MONTH 1976

TABLE 1.12

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : OCT 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.13	0.16	0.72	0.49	0.20	0.09	0.22	0.04	2.06
0.31 --	4.99	1.39	2.42	8.06	1.70	1.66	2.89	7.50	1.39	27.02
5.00 --	0.99	0.27	0.96	0.59	0.56	0.63	3.02	12.01	0.29	27.33
10.00 --	14.99	0.07	0.07	7.71	0.25	0.04	1.61	10.98	0.07	20.79
15.00 --	19.99	0.0	0.04	3.94	0.0	0.0	0.56	6.50	0.0	11.04
20.00 --	24.99	0.0	0.02	1.61	0.0	0.0	0.34	4.23	0.0	6.21
25.00 --	77.99	0.0	0.0	0.76	0.0	0.0	0.18	4.61	0.0	5.56
COLUMN SUMS	1.86	3.67	32.39	3.00	2.53	8.69	46.06	1.79	100.00	

RESULTANT CURRENT IS 3.66 CM/S AT 241 DEG FROM NORTH
 MEAN CURRENT IS 10.48 CM/S
 MAXIMUM CURRENT IS 77.00 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.35
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 1 TH DAY OF 10 TH MONTH 1976
 ENDED AT 23.58 HRS. ON 31 TH DAY OF 10 TH MONTH 1976

TABLE 1.13

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : NOV 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.06	0.09	0.34	0.09	0.09	0.23	0.03	0.0	0.91
0.31 --	2.99	0.14	0.88	6.92	0.88	0.57	1.84	3.03	0.28	14.54
3.00 --	5.99	0.06	0.54	8.65	0.48	0.14	2.81	7.11	0.17	19.95
6.00 --	8.99	0.11	0.23	8.28	0.14	0.06	1.33	7.57	0.11	17.83
9.00 --	11.99	0.0	0.06	6.63	0.03	0.03	0.99	6.55	0.0	14.29
12.00 --	14.99	0.0	0.0	4.99	0.0	0.03	0.65	4.62	0.06	10.35
15.00 --	52.99	0.0	0.0	7.62	0.0	0.0	0.62	13.89	0.0	22.14
COLUMN SUMS	0.37	1.79	43.42	1.62	0.91	8.48	42.80	0.62	100.00	

RESULTANT CURRENT IS 2.26 CM/S AT 226 DEG FROM NORTH
 MEAN CURRENT IS 10.39 CM/S
 MAXIMUM CURRENT IS 52.39 CM/S
 MINIMUM CURRENT IS 0.04 CM/S

TOTAL NO. READINGS 3528
 PERSISTENCE IS 0.22
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 11 TH MONTH 1976
 ENDED AT 11.57 HRS. ON 25 TH DAY OF 11 TH MONTH 1976

TABLE 1.14

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : MAY 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.31 -- 6.99	0.52	1.39	8.85	1.74	1.04	4.34	10.94	0.87	29.69	
7.00 -- 13.99	0.35	1.04	11.11	0.52	0.17	3.12	17.19	0.52	34.03	
14.00 -- 20.99	0.0	0.35	5.90	0.17	0.0	0.52	9.72	0.0	16.67	
21.00 -- 27.99	0.0	0.0	1.39	0.17	0.0	0.17	6.25	0.0	7.99	
28.00 -- 34.99	0.0	0.0	0.87	0.0	0.0	0.35	3.47	0.0	4.69	
35.00 -- 116.99	0.0	0.35	3.12	0.0	0.0	0.0	3.47	0.0	6.94	
COLUMN SUMS	0.87	3.12	31.25	2.60	1.22	8.51	51.04	1.39	100.00	

RESULTANT CURRENT IS 4.03 CM/S AT 250 DEG FROM NORTH
 MEAN CURRENT IS 14.73 CM/S
 MAXIMUM CURRENT IS 116.27 CM/S
 MINIMUM CURRENT IS 0.76 CM/S

TOTAL NO. READINGS 576
 PERSISTENCE IS 0.27
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 28 TH DAY OF 5 TH MONTH 1977
 ENDED AT 23.60 HRS. ON 31 TH DAY OF 5 TH MONTH 1977

TABLE 1.15

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUN 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 07 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-	ROW SUMS	
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49		
0.0 --	0.30	0.07	0.09	0.02	0.02	0.0	0.05	0.07	0.09	0.42
0.31 --	3.99	0.83	1.41	4.68	0.37	0.35	1.20	5.21	1.02	15.07
4.00 --	7.99	0.65	1.34	6.32	0.30	0.25	1.74	13.06	0.72	24.37
8.00 --	11.99	0.21	0.56	4.54	0.21	0.09	0.74	14.61	0.28	21.23
12.00 --	15.99	0.14	0.23	2.57	0.09	0.07	0.32	11.39	0.14	14.95
16.00 --	19.99	0.07	0.14	1.39	0.02	0.07	0.12	7.82	0.07	9.70
20.00 --	71.99	0.07	0.05	1.62	0.09	0.02	0.28	11.99	0.14	14.26
COLUMN SUMS	2.04	3.82	21.13	1.11	0.86	4.44	64.14	2.45	100.00	

RESULTANT CURRENT IS 6.80 CM/S AT 256 DEG FROM NORTH
 MEAN CURRENT IS 11.70 CM/S
 MAXIMUM CURRENT IS 71.75 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.58
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.10 HRS. ON 1 TH DAY OF 6 TH MONTH 1977
 ENDED AT 23.58 HRS. ON 30 TH DAY OF 6 TH MONTH 1977

TABLE 1.16

LOCATION CODE : 1116
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.0	0.0	0.0	0.03	0.16	0.07	0.0	0.26	
0.31 --	4.99	0.56	1.31	5.78	0.56	0.30	3.28	6.07	0.76	18.61
5.00 --	9.99	0.46	1.48	7.39	0.53	0.33	1.48	14.71	0.72	27.08
10.00 --	18.99	0.16	0.36	5.48	0.16	0.10	1.08	12.97	0.16	20.49
15.00 --	19.99	0.03	0.20	2.53	0.0	0.03	0.53	10.47	0.10	13.89
20.00 --	24.99	0.0	0.16	1.38	0.0	0.0	0.23	6.14	0.10	8.01
25.00 --	75.99	0.0	0.13	1.54	0.0	0.0	0.13	9.65	0.20	11.65
COLUMN SUMS	1.21	3.64	24.10	1.25	0.79	6.89	60.08	2.04	100.00	

RESULTANT CURRENT IS 6.84 CM/S AT 255 DEG FROM NORTH
 MEAN CURRENT IS 13.16 CM/S
 MAXIMUM CURRENT IS 75.57 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 3046
 PERSISTENCE IS 0.52
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 7.5 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.08 HRS. ON 1 TH DAY OF 7 TH MONTH 1977
 ENDED AT 3.37 HRS. ON 22 TH DAY OF 7 TH MONTH 1977

TABLE 1.17

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.0	0.10	0.25	0.05	0.0	0.12	0.22	0.0	0.74	
0.31 -- 6.99	0.89	3.08	16.64	1.71	1.04	5.56	14.71	1.14	44.77	
7.00 -- 13.99	0.42	1.39	13.10	0.30	0.30	2.36	11.86	0.37	30.08	
14.00 -- 20.99	0.05	0.32	6.27	0.02	0.02	0.62	6.20	0.05	13.57	
21.00 -- 27.99	0.0	0.05	2.26	0.0	0.0	0.12	3.12	0.02	5.58	
28.00 -- 34.99	0.0	0.02	1.29	0.0	0.0	0.02	1.56	0.0	2.90	
35.00 -- 125.99	0.0	0.05	0.64	0.0	0.0	0.10	1.56	0.0	2.36	
COLUMN SUMS	1.36	5.01	40.45	2.08	1.36	8.90	39.24	1.59	100.00	

RESULTANT CURRENT IS 0.95 CM/S AT 258 DEG FROM NORTH
 MEAN CURRENT IS 10.48 CM/S
 MAXIMUM CURRENT IS 125.98 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4032
 PERSISTENCE IS 0.09
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.05 HRS. ON 3 TH DAY OF 6 TH MONTH 1976
 ENDED AT 23.53 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE 1.18

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.11	0.13	1.55	0.16	0.13	0.43	1.23	0.16	3.90
0.31 --	2.99	0.40	2.17	10.64	0.78	0.63	2.78	8.94	0.92	27.26
3.00 --	5.99	0.29	1.34	8.53	0.69	0.38	1.93	10.75	0.74	24.66
6.00 --	8.99	0.20	0.87	7.24	0.16	0.11	1.23	7.35	0.13	17.29
9.00 --	11.99	0.09	0.34	4.64	0.11	0.09	0.43	4.46	0.04	10.19
12.00 --	14.99	0.0	0.20	3.14	0.0	0.02	0.13	2.73	0.07	6.29
15.00 --	49.99	0.0	0.11	4.12	0.0	0.02	0.29	5.85	0.0	10.39
COLUMN SUMS	1.10	5.17	39.85	1.90	1.39	7.21	41.31	2.06	100.00	

RESULTANT CURRENT IS 0.60 CM/S AT 261 DEG FROM NORTH
 MEAN CURRENT IS 6.91 CM/S
 MAXIMUM CURRENT IS 49.91 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.09
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 23.52 HRS. ON 31 TH DAY OF 7 TH MONTH 1976

TABLE 1.19

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : AUG 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.03	0.19	0.50	0.09	0.09	0.22	0.38	0.06	1.57	
0.31 -- 2.99	0.50	1.82	9.34	1.19	0.72	2.23	8.06	1.19	25.05	
3.00 -- 5.99	0.31	1.10	10.78	1.16	0.56	1.44	12.10	1.00	28.46	
6.00 -- 8.99	0.16	0.50	6.65	0.13	0.03	0.72	7.62	0.38	16.18	
9.00 -- 11.99	0.16	0.28	4.95	0.03	0.0	0.38	5.83	0.22	11.85	
12.00 -- 14.99	0.0	0.09	2.95	0.0	0.0	0.13	3.42	0.0	6.58	
15.00 -- 44.99	0.0	0.13	3.48	0.0	0.0	0.13	6.55	0.03	10.31	
COLUMN SUMS	1.16	4.11	38.65	2.60	1.41	5.24	43.95	2.88	100.00	

RESULTANT CURRENT IS 1.01 CM/S AT 271 DEG FROM NORTH TOTAL NO. READINGS 3190
 MEAN CURRENT IS 7.06 CM/S PERSISTENCE IS 0.14
 MAXIMUM CURRENT IS 44.06 CM/S READINGS TAKEN EVERY 10 MIN
 MINIMUM CURRENT IS 0.0 CM/S

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.02 HRS. ON 1 TH DAY OF 8 TH MONTH 1976
 ENDED AT 3.30 HRS. ON 23 TH DAY OF 8 TH MONTH 1976

TABLE 1.20

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : OCT 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.16	0.25	0.47	0.0	0.04	0.13	0.27	0.25	1.57	
0.31 -- 0.99	0.45	2.71	7.89	1.37	0.49	1.14	9.09	2.11	25.25	
5.00 -- 9.99	0.34	1.28	10.35	1.03	0.16	0.90	14.20	0.60	28.85	
10.00 -- 14.99	0.11	0.47	7.53	0.09	0.04	0.43	11.45	0.16	20.27	
15.00 -- 19.99	0.02	0.25	4.75	0.0	0.02	0.29	6.68	0.02	12.03	
20.00 -- 24.99	0.0	0.16	2.04	0.0	0.0	0.16	3.54	0.02	5.91	
25.00 -- 79.99	0.0	0.04	1.41	0.0	0.0	0.07	4.59	0.0	6.12	
COLUMN SUMS	1.08	5.15	34.43	2.49	0.76	3.11	49.82	3.16	100.00	

RESULTANT CURRENT IS 2.55 CM/S AT 261 DEG FROM NORTH
 MEAN CURRENT IS 10.73 CM/S
 MAXIMUM CURRENT IS 79.02 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.24
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.05 HRS. ON 1 TH DAY OF 10 TH MONTH 1976
 ENDED AT 23.53 HRS. ON 31 TH DAY OF 10 TH MONTH 1976

TABLE 1.21

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : NOV 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 07 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.12	0.09	0.37	0.0	0.14	0.23	0.32	0.0	1.27	
0.31 -- 2.99	0.12	1.52	4.60	0.75	0.46	1.12	4.28	0.12	12.97	
3.00 -- 5.99	0.20	1.06	7.59	0.17	0.14	1.52	8.05	0.17	18.92	
6.00 -- 8.99	0.20	0.63	7.68	0.17	0.09	0.55	8.11	0.17	17.60	
9.00 -- 11.99	0.03	0.26	6.58	0.12	0.06	0.40	7.16	0.12	14.72	
12.00 -- 14.99	0.0	0.26	4.74	0.0	0.03	0.46	5.15	0.03	10.67	
15.00 -- 50.99	0.0	0.46	8.91	0.0	0.0	0.09	14.40	0.0	23.86	
COLUMN SUMS	0.66	4.28	40.48	1.21	0.92	4.37	47.47	0.60	100.00	

RESULTANT CURRENT IS 1.55 CM/S AT 259 DEG FROM NORTH
 MEAN CURRENT IS 10.78 CM/S
 MAXIMUM CURRENT IS 50.14 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 3478
 PERSISTENCE IS 0.14
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M DE WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 11 TH MONTH 1976
 ENDED AT 3.42 HRS. ON 25 TH DAY OF 11 TH MONTH 1976

TABLE 1.22

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : MAY 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES											
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-			
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS		
0.0 -- 0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.31 -- 5.99	3.30	8.51	0.52	1.04	1.56	6.77	0.17	1.22	23.09		
6.00 -- 11.99	1.04	18.23	1.22	0.52	0.69	8.33	0.0	0.52	30.56		
12.00 -- 17.99	0.52	14.93	0.0	0.0	0.17	5.90	0.0	0.0	21.53		
18.00 -- 23.99	0.17	8.85	0.0	0.52	0.0	3.82	0.0	0.0	13.37		
24.00 -- 29.99	0.0	2.26	0.0	0.0	0.0	1.91	0.0	0.0	4.17		
30.00 -- 110.99	0.0	3.82	0.0	0.0	0.0	3.47	0.0	0.0	7.29		
COLUMN SUMS	5.03	56.60	1.74	2.08	2.43	30.21	0.17	1.74	100.00		

RESULTANT CURRENT IS 3.66 CM/S AT 48 DEG FROM NORTH
 MEAN CURRENT IS 14.08 CM/S
 MAXIMUM CURRENT IS 110.79 CM/S
 MINIMUM CURRENT IS 0.45 CM/S

TOTAL NO. READINGS 576
 PERSISTENCE IS 0.26
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.05 HRS. ON 28 TH DAY OF 5 TH MONTH 1977
 ENDED AT 23.55 HRS. ON 31 TH DAY OF 5 TH MONTH 1977

TABLE 1.23

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUN 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.07	0.49	0.12	0.02	0.02	0.09	0.07	0.05	0.93
0.31 --	3.99	1.06	7.41	0.76	0.16	0.39	5.51	0.76	0.46	16.53
4.00 --	7.99	0.53	15.81	0.37	0.16	0.42	5.46	0.42	0.19	23.36
8.00 --	11.99	0.42	17.57	0.14	0.05	0.21	2.45	0.23	0.12	21.18
12.00 --	15.99	0.09	15.39	0.07	0.07	0.09	1.23	0.09	0.0	17.04
16.00 --	19.99	0.05	9.98	0.07	0.02	0.0	0.56	0.02	0.02	10.72
20.00 --	63.99	0.0	8.68	0.05	0.0	0.0	1.53	0.0	0.0	10.25
COLUMN SUMS	2.22	75.32	1.57	0.49	1.13	16.83	1.60	0.83	100.00	

RESULTANT CURRENT IS 7.56 CM/S AT 45 DEG FROM NORTH
 MEAN CURRENT IS 10.78 CM/S
 MAXIMUM CURRENT IS 63.98 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.70
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.05 HRS. ON 1 TH DAY OF 6 TH MONTH 1977
 ENDED AT 23.53 HRS. ON 30 TH DAY OF 6 TH MONTH 1977

TABLE 1.24

LOCATION CODE : 1101
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 77
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.56	5.08	0.30	0.20	0.49	2.43	0.10	0.39	9.54	
0.31 -- 2.99	2.20	17.87	0.33	0.23	1.38	4.85	0.59	0.56	28.01	
3.00 -- 5.99	0.62	14.66	0.20	0.10	0.16	2.07	0.33	0.10	18.24	
6.00 -- 8.99	0.23	9.94	0.03	0.10	0.07	1.64	0.13	0.03	12.17	
9.00 -- 11.99	0.10	8.46	0.03	0.0	0.03	0.66	0.07	0.0	9.35	
12.00 -- 14.99	0.07	6.00	0.0	0.0	0.16	0.56	0.0	0.0	6.79	
15.00 -- 50.99	0.07	14.00	0.03	0.0	0.07	1.74	0.0	0.0	15.91	
COLUMN SUMS	3.84	76.02	0.92	0.62	2.36	13.94	1.21	1.08	100.00	

RESULTANT CURRENT IS	5.54 CM/S AT	44 DEG FROM NORTH	TOTAL NO. READINGS	3049
MEAN CURRENT IS	7.36 CM/S		PERSISTENCE IS	0.75
MAXIMUM CURRENT IS	50.52 CM/S		READINGS TAKEN EVERY	10 MIN
MINIMUM CURRENT IS	0.0 CM/S			

METER OPERATIONS

METER OPERATED AT 6.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 7 TH MONTH 1977
 ENDED AT 4.02 HRS. ON 22 TH DAY OF 7 TH MONTH 1977

TABLE 1.25

LOCATION CODE : 1102
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO
 PERIOD : JUN 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES

SPEED (CM/S)

337.50- 22.50- 67.50- 112.50- 157.50- 202.50- 247.50- 292.50-
 22.49 67.49 112.49 157.49 202.49 247.49 292.49 337.49
 ROW SUMS

COLUMN SUMS																										
0.0	--	0.30	11.16	3.10	0.10	0.07	0.20	5.11	20.63	4.49	48.86	0.31	--	1.99	9.82	3.05	0.02	0.07	0.05	0.12	0.12	0.22	11.63	51.56	7.94	100.00
10.00	--	20.99	0.05	0.0	0.0	0.0	0.0	0.15	0.05	0.0	0.25	8.00	--	9.99	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.0	0.05	0.0	0.25
6.00	--	7.99	0.02	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.07	2.00	--	3.99	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.07
4.00	--	5.99	0.07	0.0	0.0	0.0	0.0	0.37	0.0	0.0	0.45	4.00	--	5.99	0.07	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.45
2.00	--	3.99	0.20	0.0	0.0	0.0	0.0	0.77	1.98	0.12	3.99	2.00	--	3.99	0.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.45
0.31	--	1.99	9.82	3.05	0.02	0.07	0.05	5.18	24.88	3.32	46.35	0.31	--	1.99	9.82	3.05	0.02	0.07	0.05	0.12	46.35	0.31	--	1.99	9.82	46.35
0.0	--	0.30	11.16	3.10	0.10	0.07	0.20	5.11	20.63	4.49	48.86	0.0	--	0.30	11.16	3.10	0.10	0.07	0.20	5.11	20.63	4.49	--	0.30	11.16	48.86

RESULTANT CURRENT IS

0.54 CM/S AT 290 DEG FROM NORTH

MEAN CURRENT IS

0.62 CM/S

MAXIMUM CURRENT IS

24.59 CM/S

MINIMUM CURRENT IS

0.0 CM/S

METER OPERATIONS

METER OPERATED AT 2.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.05 HRS. ON 3 TH DAY OF 6 TH MONTH 1976

ENDED AT 23.53 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE *****

LOCATION CODE : 1102
 AREA : BURLINGTON CANAL
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 53 N
 LONGITUDE : 79 47 55 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	10.75	5.80	0.07	0.15	0.07	2.85	8.92	3.58	30.21
0.31 --	0.99	18.95	3.37	0.0	0.07	0.0	4.02	11.92	1.02	39.36
1.00 --	1.99	15.51	2.49	0.0	0.0	0.0	2.34	6.07	1.02	27.43
2.00 --	2.99	0.95	0.22	0.0	0.0	0.0	0.29	1.54	0.0	3.00
3.00 --	3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00 --	4.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00 --	2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COLUMN SUMS	46.16	9.88	0.07	0.22	0.07	9.51	28.46	5.63	100.00	

RESULTANT CURRENT IS 0.47 CM/S AT 338 DEG FROM NORTH
 MEAN CURRENT IS 0.73 CM/S
 MAXIMUM CURRENT IS 2.96 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 1367
 PERSISTENCE IS 0.65
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 2.1 M FROM BOTTOM IN 9.4 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 11.43 HRS. ON 10 TH DAY OF 7 TH MONTH 1976

TABLE 1.27

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUN 76
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 --	1.99	1.17	1.26	1.29	1.26	1.17	0.82	0.95	1.26	9.19
2.00 --	2.99	1.89	1.74	2.46	2.84	1.55	1.52	2.30	3.35	17.65
3.00 --	3.99	1.99	1.52	1.36	3.50	1.55	1.42	1.80	2.43	15.56
4.00 --	4.99	2.43	2.24	2.08	2.08	1.07	1.04	2.62	1.09	15.56
5.00 --	5.99	1.29	1.74	2.49	2.15	1.17	1.10	1.45	1.55	12.94
6.00 --	6.99	1.01	1.96	1.33	1.20	0.66	0.41	1.55	1.55	9.66
7.00 --	14.99	3.00	3.41	4.26	1.58	0.19	0.22	2.68	4.10	19.44
COLUMN SUMS	12.78	13.86	15.28	14.61	7.35	6.53	13.35	16.22	100.00	

RESULTANT CURRENT IS 0.87 CM/S AT 24 DEG FROM NORTH
 MEAN CURRENT IS 4.82 CM/S
 MAXIMUM CURRENT IS 14.98 CM/S
 MINIMUM CURRENT IS 1.04 CM/S

TOTAL NO. READINGS 3168
 PERSISTENCE IS 0.18
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.06 HRS. ON 9 TH DAY OF 6 TH MONTH 1976
 ENDED AT 23.59 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE 1.28

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 --	1.99	1.21	1.41	1.12	1.10	1.73	1.81	0.87	1.90	11.16
2.00 --	2.99	3.29	2.17	1.97	1.30	1.43	3.63	3.05	2.60	19.45
3.00 --	3.99	3.52	2.87	1.86	1.17	0.83	1.34	2.78	2.60	16.96
4.00 --	4.99	2.55	4.03	1.39	0.87	0.78	0.60	1.23	2.53	14.00
5.00 --	5.99	2.96	2.91	1.43	1.43	0.29	0.49	1.05	2.35	12.93
6.00 --	6.99	2.53	1.46	1.08	0.85	0.0	0.04	0.94	2.11	9.01
7.00 --	16.99	3.97	3.09	2.69	1.01	0.0	0.0	1.37	4.37	16.49
COLUMN SUMS	20.03	17.95	11.54	7.73	5.06	7.93	11.29	18.46	100.00	

RESULTANT CURRENT IS 1.77 CM/S AT 5 DEG FROM NORTH
 MEAN CURRENT IS 4.60 CM/S
 MAXIMUM CURRENT IS 16.35 CM/S
 MINIMUM CURRENT IS 1.00 CM/S

TOTAL NO. READINGS 4463
 PERSISTENCE IS 0.38
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.09 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 23.53 HRS. ON 31 TH DAY OF 7 TH MONTH 1976

TABLE 1.29

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : AUG 74
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 --	1.99	1.76	1.54	1.60	3.15	1.57	1.67	2.13	2.10	15.52
2.00 --	2.99	2.75	3.24	3.76	1.88	1.48	1.36	4.38	7.96	26.81
3.00 --	3.99	3.09	3.12	2.47	1.23	0.12	0.93	3.09	5.77	19.81
4.00 --	4.99	3.80	2.41	1.33	0.59	0.62	0.52	1.70	3.76	14.72
5.00 --	5.99	1.54	0.89	1.42	0.59	0.31	0.06	1.88	3.86	10.55
6.00 --	6.99	1.17	0.12	1.39	0.37	0.31	0.0	1.91	2.53	7.81
7.00 --	10.99	0.56	0.0	1.08	0.59	0.34	0.0	0.96	1.27	4.78
COLUMN SUMS	14.66	11.32	13.05	8.39	4.75	4.54	16.04	27.24	100.00	

RESULTANT CURRENT IS 1.26 CM/S AT 338 DEG FROM NORTH
 MEAN CURRENT IS 3.73 CM/S
 MAXIMUM CURRENT IS 10.09 CM/S
 MINIMUM CURRENT IS 1.00 CM/S

TOTAL NO. READINGS 3241
 PERSISTENCE IS 0.34
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 8 TH MONTH 1976
 ENDED AT 11.56 HRS. ON 23 TH DAY OF 8 TH MONTH 1976

TABLE 1.30

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : MAY 77
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	0.17	0.35	5.56	1.74	0.17	1.91	6.60	0.87	17.36
0.31 --	0.99	0.17	1.74	1.91	2.08	0.69	2.08	2.26	0.87	11.81
1.00 --	1.99	0.69	1.04	4.17	5.03	1.91	0.52	3.65	6.77	23.78
2.00 --	2.99	0.35	0.17	4.51	2.43	0.17	0.35	1.74	1.22	10.94
3.00 --	3.99	0.52	0.17	4.86	4.86	0.0	0.69	3.47	0.87	15.45
4.00 --	4.99	0.17	0.35	2.43	1.39	0.0	0.0	1.74	0.87	6.94
5.00 --	10.99	0.35	4.51	0.87	1.39	0.0	0.0	5.21	1.39	13.72
COLUMN SUMS	2.43	8.33	24.31	18.92	2.95	5.56	24.65	12.85	100.00	

RESULTANT CURRENT IS	0.27 CM/S AT	52 DEG FROM NORTH	TOTAL NO. READINGS	576
MEAN CURRENT IS	2.38 CM/S		PERSISTENCE IS	0.11
MAXIMUM CURRENT IS	10.63 CM/S		READINGS TAKEN EVERY	10 MIN
MINIMUM CURRENT IS	0.0 CM/S			

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.05 HRS. ON 28 TH DAY OF 5 TH MONTH 1977
 ENDED AT 23.55 HRS. ON 31 TH DAY OF 5 TH MONTH 1977

TABLE 1.31

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUN 77
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES											
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-			
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS		
0.0 --	0.30	5.51	4.98	2.18	3.63	3.61	0.28	1.60	3.22	25.00	
0.31 --	0.99	2.73	1.39	0.95	0.16	0.60	0.58	1.16	1.81	9.38	
1.00 --	1.99	9.37	3.98	5.14	0.44	0.86	1.18	2.78	4.33	28.08	
2.00 --	2.99	2.89	3.54	1.78	0.12	0.39	0.97	2.36	4.10	16.16	
3.00 --	3.99	1.69	2.69	1.20	0.51	0.56	1.04	1.92	1.74	11.34	
4.00 --	4.99	0.65	2.01	0.93	0.28	0.42	0.23	1.20	0.83	6.55	
5.00 --	9.99	0.37	0.83	0.23	0.09	0.14	0.49	0.67	0.67	3.50	
COLUMN SUMS	23.22	19.42	12.41	5.23	6.57	4.77	11.69	16.69	100.00		

RESULTANT CURRENT IS 0.67 CM/S AT 357 DEG FROM NORTH
 MEAN CURRENT IS 1.67 CM/S
 MAXIMUM CURRENT IS 9.13 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.40
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.05 HRS. ON 1 TH DAY OF 6 TH MONTH 1977
 ENDED AT 23.53 HRS. ON 30 TH DAY OF 6 TH MONTH 1977

TABLE 1.32

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUL 77
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	1.90	0.74	1.37	2.22	3.00	2.46	4.23	0.96	16.89
0.31 --	1.99	1.95	4.53	6.85	3.54	2.89	3.81	10.10	10.42	44.09
2.00 --	3.99	2.46	2.89	2.60	1.48	0.27	2.49	5.91	4.70	22.80
4.00 --	5.99	0.90	1.10	1.90	0.22	0.04	0.40	2.40	3.43	10.39
6.00 --	7.99	1.05	0.20	0.45	0.0	0.0	0.22	1.68	0.52	4.12
8.00 --	9.99	0.0	0.36	0.11	0.0	0.0	0.0	0.16	0.56	1.19
10.00 --	28.99	0.0	0.38	0.13	0.0	0.0	0.0	0.0	0.0	0.52
COLUMN SUMS	8.27	10.19	13.42	7.46	6.21	9.39	24.48	20.59	100.00	

RESULTANT CURRENT IS 0.72 CM/S AT 319 DEG FROM NORTH
 MEAN CURRENT IS 2.05 CM/S
 MAXIMUM CURRENT IS 28.00 CM/S
 MINIMUM CURRENT IS 0.0 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.35
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 7 TH MONTH 1977
 ENDED AT 23.51 HRS. ON 31 TH DAY OF 7 TH MONTH 1977

TABLE 1.33

LOCATION CODE : 1104
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : AUG 77
 LATITUDE : 43 17 28 N
 LONGITUDE : 79 49 56 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 --	0.30	1.11	3.83	0.82	0.55	0.16	1.37	0.92	2.48	11.25
0.31 --	1.99	6.24	10.22	4.73	1.29	2.77	2.91	7.93	8.61	44.70
2.00 --	3.99	3.06	6.00	2.38	0.50	1.37	3.25	5.50	4.31	26.37
4.00 --	5.99	0.61	2.35	0.90	0.40	0.21	0.87	3.80	2.54	11.68
6.00 --	7.99	0.21	1.22	0.26	0.03	0.0	0.0	0.34	0.66	2.72
8.00 --	9.99	0.08	0.08	0.48	0.03	0.0	0.0	0.42	0.21	1.29
10.00 --	18.99	0.08	1.22	0.18	0.0	0.0	0.0	0.26	0.24	1.98
COLUMN SUMS	11.39	24.91	9.75	2.80	4.52	8.40	19.18	19.05	100.00	

RESULTANT CURRENT IS	0.78 CM/S	AT 345 DEG FROM NORTH	TOTAL NO. READINGS	3785
MEAN CURRENT IS	2.35 CM/S		PERSISTENCE IS	0.33
MAXIMUM CURRENT IS	18.00 CM/S		READINGS TAKEN EVERY	10 MIN
MINIMUM CURRENT IS	0.0 CM/S			

METER OPERATIONS

METER OPERATED AT 16.3 M FROM BOTTOM IN 22.9 M OF WATER

STARTED AT	0.01 HRS.	ON	1 TH DAY OF	8 TH MONTH	1977
ENDED AT	6.40 HRS.	ON	27 TH DAY OF	8 TH MONTH	1977

TABLE 1.34

LOCATION CODE : 1109
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : MAY 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-	ROW SUMS	
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49		
0.0 -- 0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.31 -- 2.99	0.0	0.0	15.67	6.93	1.66	8.32	14.29	0.0	46.88	
3.00 -- 5.99	0.0	0.0	2.77	0.83	0.14	0.42	1.53	0.0	5.69	
6.00 -- 8.99	0.0	0.0	3.19	1.53	0.42	0.55	2.77	0.0	8.46	
9.00 -- 11.99	0.0	0.0	3.88	0.14	0.14	0.97	1.66	0.0	6.80	
12.00 -- 14.99	0.0	0.0	1.80	0.42	0.0	0.28	2.64	0.0	5.13	
15.00 -- 48.99	0.0	0.0	18.31	0.42	0.0	0.0	8.32	0.0	27.05	
COLUMN SUMS	0.0	0.0	45.63	10.26	2.36	10.54	31.21	0.0	100.00	

RESULTANT CURRENT IS 3.28 CM/S AT 84 DEG FROM NORTH
 MEAN CURRENT IS 9.83 CM/S
 MAXIMUM CURRENT IS 48.57 CM/S
 MINIMUM CURRENT IS 0.96 CM/S

TOTAL NO. READINGS 721
 PERSISTENCE IS 0.33
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.0 HRS. ON 27 TH DAY OF 5 TH MONTH 1976
 ENDED AT 23.59 HRS. ON 31 TH DAY OF 5 TH MONTH 1976

TABLE 1.35

LOCATION CODE : 1109
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUN 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 -- 5.99	0.02	0.0	1.04	1.92	1.69	1.71	1.83	0.07	8.29	
6.00 -- 10.99	0.0	0.07	4.17	3.87	1.90	3.75	5.28	0.0	19.03	
11.00 -- 15.99	0.0	0.19	5.74	2.69	1.09	2.01	5.05	0.0	16.76	
16.00 -- 20.99	0.0	0.21	6.50	1.53	0.32	1.37	4.70	0.0	14.63	
21.00 -- 25.99	0.0	0.21	5.76	0.56	0.16	0.42	4.63	0.0	11.74	
26.00 -- 30.99	0.0	0.32	4.24	0.14	0.09	0.25	3.47	0.0	8.52	
31.00 -- 87.99	0.0	0.69	13.33	0.19	0.07	0.19	6.57	0.0	21.04	
COLUMN SUMS	0.02	1.69	40.79	10.88	5.32	9.70	31.53	0.07	100.00	

RESULTANT CURRENT IS 4.25 CM/S AT 98 DEG FROM NORTH
 MEAN CURRENT IS 21.13 CM/S
 MAXIMUM CURRENT IS 87.91 CM/S
 MINIMUM CURRENT IS 1.51 CM/S

TOTAL NO. READINGS 4320
 PERSISTENCE IS 0.20
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.09 HRS. ON 1 TH DAY OF 6 TH MONTH 1976
 ENDED AT 23.56 HRS. ON 30 TH DAY OF 6 TH MONTH 1976

TABLE 1.36

LOCATION CODE : 1100
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : JUL 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 --	4.99	0.02	0.04	5.87	4.05	1.93	3.90	7.97	0.0	23.79
5.00 --	8.99	0.0	0.07	3.61	3.05	0.76	3.79	4.08	0.0	15.34
9.00 --	12.99	0.0	0.04	5.24	2.76	0.40	1.75	5.24	0.0	15.43
13.00 --	16.99	0.0	0.0	5.82	0.94	0.13	0.69	4.44	0.0	12.03
17.00 --	20.99	0.0	0.0	5.35	0.22	0.07	0.22	3.29	0.0	9.16
21.00 --	24.99	0.0	0.0	4.46	0.16	0.02	0.02	2.84	0.0	7.50
25.00 --	69.99	0.0	0.07	11.87	0.04	0.0	0.02	4.73	0.0	16.73
COLUMN SUMS	0.02	0.22	42.23	11.22	3.32	10.39	32.59	0.0	100.00	

RESULTANT CURRENT IS 3.56 CM/S AT 89 DEG FROM NORTH
 MEAN CURRENT IS 14.27 CM/S
 MAXIMUM CURRENT IS 69.36 CM/S
 MINIMUM CURRENT IS 1.00 CM/S

TOTAL NO. READINGS 4464
 PERSISTENCE IS 0.25
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.06 HRS. ON 1 TH DAY OF 7 TH MONTH 1976
 ENDED AT 23.53 HRS. ON 31 TH DAY OF 7 TH MONTH 1976

TABLE 1.37

LOCATION CODE : 1100
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO
 PERIOD : AUG 74
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES

SPEED(CM/S)

337.50- 22.50- 67.50- 112.50- 157.50- 202.50- 247.50- 292.50-
 22.49 67.49 112.49 157.49 202.49 247.49 292.49 337.49
 ROW SUMS

1.00 --	4.00 --	0.03	0.25	1.23	1.48	1.05	1.67	1.88	0.19	7.78	17.26	18.46	15.34	12.01	9.73	19.42
5.00 --	8.00 --	0.00	0.10	3.58	3.77	1.39	2.55	4.75	0.03	7.26	17.26	18.46	15.34	12.01	9.73	19.42
9.00 --	12.00 --	0.00	0.12	6.11	3.06	1.23	2.19	5.74	0.00	17.26	17.26	18.46	15.34	12.01	9.73	19.42
13.00 --	16.00 --	0.00	0.09	6.48	1.45	0.40	1.11	5.80	0.00	15.34	15.34	18.46	15.34	12.01	9.73	19.42
17.00 --	20.00 --	0.00	0.00	5.71	0.49	0.15	0.43	5.22	0.00	12.01	12.01	15.34	12.01	9.73	9.73	19.42
21.00 --	24.00 --	0.00	0.12	5.56	0.09	0.03	0.28	3.64	0.00	9.73	9.73	15.34	12.01	9.73	9.73	19.42
25.00 --	65.00 --	0.00	0.00	13.68	0.12	0.03	0.03	5.56	0.00	19.42	19.42	15.34	12.01	9.73	9.73	19.42
COLUMN SUMS																
0.03	0.77	42.36	10.47	4.29	9.26	32.60	0.22	100.00								

RESULTANT CURRENT IS
 3.37 CM/S AT
 98 DEG FROM NORTH
 MEAN CURRENT IS
 16.69 CM/S
 MAXIMUM CURRENT IS
 65.48 CM/S
 MINIMUM CURRENT IS
 1.00 CM/S

TOTAL NO. READINGS 3239
 PERSISTENCE IS 0.20
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.03 HRS. ON 1 TH DAY OF 8 TH MONTH 1976
 ENDED AT 11.30 HRS. ON 23 TH DAY OF 8 TH MONTH 1976

TABLE 1.38

LOCATION CODE : 1109
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : SEP 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
1.00 -- 5.99	0.15	5.11	1.88	0.80	0.23	0.03	0.59	0.03	6.81	
6.00 -- 10.99	0.33	5.37	3.96	2.42	1.57	0.54	1.93	0.28	16.39	
11.00 -- 15.99	0.28	4.42	4.27	2.75	1.46	0.36	2.03	0.41	15.98	
16.00 -- 20.99	0.46	3.52	3.98	2.11	1.03	0.18	1.67	0.21	13.16	
21.00 -- 25.99	0.51	2.36	3.26	2.39	0.87	0.10	1.31	0.05	10.87	
26.00 -- 30.99	0.49	1.41	3.01	2.26	0.59	0.08	1.21	0.10	9.15	
31.00 -- 85.99	0.90	2.54	12.92	6.63	2.00	0.03	2.26	0.36	27.65	
COLUMN SUMS	3.13	22.74	33.27	19.35	7.76	1.31	11.00	1.40	100.00	

RESULTANT CURRENT IS 13.71 CM/S AT 92 DEG FROM NORTH
 MEAN CURRENT IS 24.17 CM/S
 MAXIMUM CURRENT IS 85.23 CM/S
 MINIMUM CURRENT IS 1.84 CM/S

TOTAL NO. READINGS 3892
 PERSISTENCE IS 0.57
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.0 HRS. ON 4 TH DAY OF 9 TH MONTH 1976
 ENDED AT 23.57 HRS. ON 30 TH DAY OF 9 TH MONTH 1976

TABLE 1.39

LOCATION CODE : 1109
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : OCT 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
0.0 -- 0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.31 -- 0.99	0.09	0.16	1.43	1.61	1.39	1.54	1.34	0.11	7.68	
5.00 -- 9.99	0.07	0.56	2.66	3.54	2.55	2.48	2.35	0.0	14.22	
10.00 -- 14.99	0.02	0.94	3.60	3.31	1.79	2.44	2.42	0.0	14.53	
15.00 -- 19.99	0.0	1.52	4.48	2.42	0.99	1.77	3.11	0.0	14.28	
20.00 -- 24.99	0.0	1.75	4.10	1.39	0.56	0.94	2.46	0.0	11.19	
25.00 -- 79.99	0.0	6.47	19.23	2.35	0.36	1.30	8.39	0.0	38.10	
COLUMN SUMS	0.18	11.39	35.50	14.62	7.63	10.48	20.08	0.11	100.00	

RESULTANT CURRENT IS 8.05 CM/S AT 93 DEG FROM NORTH
 MEAN CURRENT IS 21.76 CM/S
 MAXIMUM CURRENT IS 79.24 CM/S
 MINIMUM CURRENT IS 0.96 CM/S

TOTAL NO. READINGS 4467
 PERSISTENCE IS 0.37
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.2 M FROM BOTTOM IN 3.7 M DE WATER

STARTED AT 0.07 HRS. ON 1 TH DAY OF 10 TH MONTH 1976
 ENDED AT 23.50 HRS. ON 31 TH DAY OF 10 TH MONTH 1976

TABLE 1.40

LOCATION CODE : 1109
 AREA : HAMILTON HARBOUR
 LAKE : ONTARIO

PERIOD : NOV 76
 LATITUDE : 43 16 47 N
 LONGITUDE : 79 53 26 W

FREQUENCY TABLE

DIRECTION (COMING FROM) IN DEGREES										
SPEED (CM/S)	337.50-	22.50-	67.50-	112.50-	157.50-	202.50-	247.50-	292.50-		
	22.49	67.49	112.49	157.49	202.49	247.49	292.49	337.49	ROW SUMS	
2.00 --	5.99	0.0	0.12	0.71	0.97	1.00	1.15	0.68	0.06	4.70
6.00 --	9.99	0.0	0.53	1.89	2.86	1.65	1.62	1.30	0.03	9.89
10.00 --	13.99	0.03	0.59	3.63	2.27	1.54	2.39	1.86	0.09	12.40
14.00 --	17.99	0.12	0.62	3.90	1.39	0.71	1.74	3.34	0.12	11.93
18.00 --	21.99	0.0	1.06	3.75	0.92	0.38	1.06	3.60	0.0	10.78
22.00 --	25.99	0.0	1.21	4.84	0.41	0.27	0.59	3.63	0.0	10.96
26.00 --	70.99	0.0	4.75	22.18	0.18	0.06	1.86	10.31	0.0	39.34
COLUMN SUMS	0.15	8.89	40.90	9.01	5.61	10.43	24.72	0.30	100.00	

RESULTANT CURRENT IS 6.73 CM/S AT 86 DEG FROM NORTH
 MEAN CURRENT IS 23.72 CM/S
 MAXIMUM CURRENT IS 70.25 CM/S
 MINIMUM CURRENT IS 2.37 CM/S

TOTAL NO. READINGS 3386
 PERSISTENCE IS 0.28
 READINGS TAKEN EVERY 10 MIN

METER OPERATIONS

METER OPERATED AT 1.9 M FROM BOTTOM IN 3.7 M OF WATER

STARTED AT 0.0 HRS. ON 1 TH DAY OF 11 TH MONTH 1976
 ENDED AT 11.31 HRS. ON 24 TH DAY OF 11 TH MONTH 1976